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DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. XII. No. 144

DECEMBER, 1931.

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QUAINT DESIGNS IN MEXICAN POTTERY.

(See page 390)

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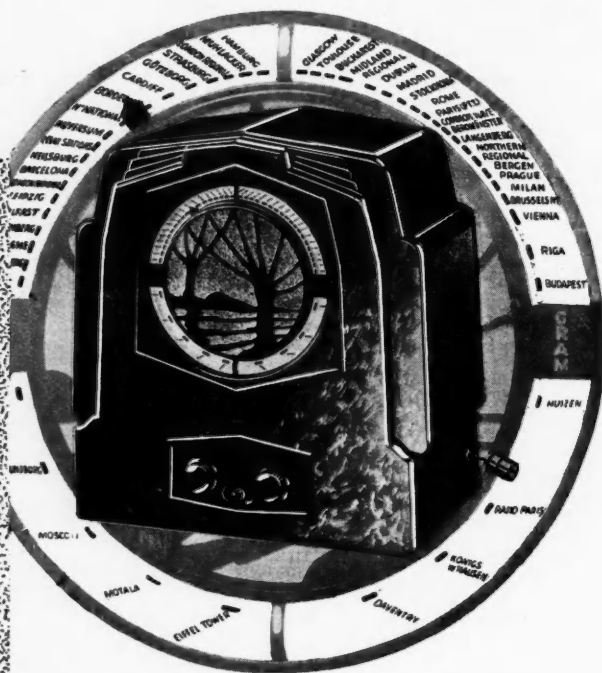
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DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. XII. No. 144. DECEMBER, 1931.

PRICE 1s. NET

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Notes of the Month.

A HUGE marble statue of the Emperor Hadrian is among the most important discoveries of the past season at the Agora of Athens. The excavations are directed by Professor T. L. Shear, professor of classical archaeology at Princeton, who outlined the work in *Discovery* last April. The statue just discovered was found in a breach in the walls of the Agora and is too large to be removed through the entrance made by the excavators. It lies beneath a house which has not yet been purchased so that it cannot be removed at present. Professor Shear believes that the statue is one mentioned by Pausanias, the learned traveller who made a tour of Greece in the second century and recorded the position of various monuments. The statue then stood by the Zeus Stoa. According to reports from Athens, the emperor's breastplate is highly decorated, a beautiful representation of Athena on the back of a wolf being shown in the centre. Other objects recently excavated include a statue of a woman, a number of Greek and Roman lamps, and a fine collection of pottery of various periods. Work on the site was commenced last spring and will be resumed in January. Much important material has already been disclosed.

Professor Piccard's successful balloon ascent to a height of ten miles, which was the subject of an article in *Discovery* in July, has encouraged two British balloonists to follow the Swiss scientist's lead. The new ascent is planned on more ambitious lines, for it is

expected that a height of at least fifteen miles will be reached without difficulty. The carriage of the balloon is constructed of aluminium and will be hermetically sealed before the ascent. According to *The Times*, precise calculations have been made as to the amount of gas expansion to be allowed for in the ascent, and the dimensions of the balloon are being determined accordingly. Expansion cannot be counteracted in this case by valves, because little ballast will be carried, and a large volume of gas will be needed to ensure a steady descent. It is necessary, therefore, to have a balloon of unusually large proportions which will rise from the ground only partially filled with hydrogen. Other calculations as to the rate of lift in a constantly diminishing pressure have led to the belief that the ascent to maximum altitude may be made in little more than an hour. The whole adventure, it is thought, may be over within five or six hours.

In these days of financial stress it is interesting to discover the expedients adopted on similar occasions in the past. A letter has come to light at Princeton University which reveals that payment in kind was accepted from undergraduates after the American Revolution. Money was scarce, paper currency was worth little and food was difficult to obtain, so the authorities took foodstuffs and clothing in place of fees. In 1779 the principal of the University, Dr. Witherspoon, wrote to a parent that some students paid half and others all of their bills in kind, and he would be glad to accept an offer of tea and sugar for this purpose. The letter reads: "In the present extreme difficulty of finding provisions, even hard money does not go much above half as far as it used to. Please, therefore, send by the first safe opportunity six pounds of Bohea tea and a barrel of sugar. It is also very agreeable to my wife what you mention of a piece of silk, as she has bought no clothes for these four years."

It has been felt for some time that the international congress of prehistoric science which was interrupted by the war should be resumed, and we are glad

to note that a new congress has now been formed. Its first session will be held in London next August. This announcement was made by Sir Charles Peers at the recent congress of archaeological studies. The new society will embrace anthropology, geology, archaeology, folk-lore and the palaeontology of plants and animals, and meetings will be held every four years. Before the war, an international congress of prehistoric science flourished for over forty years, the first meeting being held in 1865. The international collaboration which the congress made possible was of the highest value, and a renewal of these activities will be welcomed by workers in various countries.

* * * * *

The complete excavation of the Roman villa at Camborne, which was recently announced, closes the investigation of a site unique in the Duchy. It is remarkable that this should be the only Roman villa known to have existed in what is now Cornwall, since the neighbouring area of Somerset was popular with the Romans, who were attracted there in the first instance by the lead of the Mendips, but appear to have found it very suitable as a site of residence. The largest known Roman villa in the British Isles is situated at Keynsham. Although the plan and technique of the Cornish villa are thoroughly Roman in character, the absence of certain usual features of Romano-British culture (such as the characteristic Samian ware and bronze ornaments), as well as the small number of coins found, suggest that it was the dwelling of a Romanized Britain. We may therefore conclude that the well-known exclusiveness of the Cornish people towards the "foreigner" is a trait of local character, reinforced by geographical conditions, which antedates the segregation of the British in this part of the island by Saxon and Norman invader. The coins found in the villa range in date from A.D. 190 to A.D. 270, the latter date approximating to a time when Irish raiders were active and may have caused the evacuation of the villa. When the full account of the excavation is published it will no doubt throw fresh light on the relation of Roman and indigenous culture—in some respects the most interesting aspect of the study of Romano-British antiquities.

* * * * *

Those who have had an opportunity of seeing the remarkable natural history films which are a comparatively recent addition to cinema programmes have been attracted by their possibilities in the field of science. The future of scientific films is discussed on another page. Many fascinating productions can now be seen, the best known being Captain Knight's studies of the golden eagle, Mr. Cherry Kearton's

penguin film and the more recent "Secrets of Nature" series with sound. Scientific films are already being adopted as part of the curriculum in many schools, and in America production has been commenced by the universities themselves with very promising results. This lead has not yet been followed in England, but it is hoped that production of scientific films may be adopted before long as part of the regular activities of scientific bodies in this country.

* * * * *

Investigations recently conducted in Colorado and Arizona by Mr. F. Roberts, junior, on behalf of the Bureau of American Ethnology, have thrown valuable light on the stage of development reached in the late Basket Maker and early Puebloan phases. In Colorado he has found that the houses are still single-chambered, but there is a tendency to what appears to have been a clan group of five or six houses erected closely adjacent, if not actually contiguous. Contrary to the generally accepted view, then, here the houses had become rectangular before the practice of building them in contiguity was followed. In Arizona, on the other hand, Mr. Roberts has discovered the circular houses still partly subterranean and entered from the roof; they are erected closely side by side in rows. In either case the practice of saving labour and material by building the houses in terraces with only a single party-wall had not been attained. This, however, was obviously the next stage towards that in which the single-chambered houses are placed side by side and one on top of another, to form the characteristic community house.

* * * * *

An interesting theory on the origin and meaning of sword dances has been advanced by a Viennese expert. It is usual to regard this type of dance as a survival of the fertility ceremonial, but in a lecture to the English Folk Dance Society, Dr. Wolfram of Vienna suggested that the sword dance is "a manifestation of the tendency among young men to form secret societies with initiatory rites." The central feature of the ceremonial dance then becomes the simulation of the initiate's death, thus admitting him to the new life as in the initiatory rites of primitive societies. Other folk dances are thus brought into relation with the cult of death. Dr. Wolfram maintains that the morris dance, for instance, is the dance of performers whose faces are blackened and who represent the army of the dead, recalling the behaviour of children at the various seasonal festivals. It would be interesting to know how far this theory of secret societies may account for the popularity of the folk dance among members of the Youth Movement in Germany.

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"Science and Human Experience."

By Sir Arthur Eddington, F.R.S.

In a new book Professor Dingle rebels against the views of Sir Arthur Eddington and Sir James Jeans. Sir Arthur here assumes the rôle of the prisoner on trial and replies to the "speech of the prosecuting counsel."

"In reading what these men (Jeans and Eddington) have written I have found my acceptance of their positions opposed by an instinctive rebellion which I am convinced is at bottom rational, and this book is largely an attempt to formulate the sources of that rebellion."

I had intended to examine Professor Dingle's new book* from the standpoint of a detached reviewer, but on reading this passage from the preface good resolutions were dissipated. I was the prisoner on trial listening to the speech of the prosecuting counsel; on any page the deadly thrust might come. A reviewer should ask, "Does this passage make the main principle generally clear to the lay reader?" the accused asks, "Does it contain a subtle distortion which is going to be turned against me later on?" Vaguely I am aware that my friend Professor Dingle has produced a well-written and interesting book; but it must be left to other reviewers to expatiate on that.

There seem to be substantial differences between Dingle's views and mine, but I do not think he is right as to the source of the divergence. On page 71 he explains that the fundamental difference is that I regard the conceptual scheme as in some sense "truer" than the familiar world, whereas he regards it as revealing a connecting link between the diverse elements of that world. But the conceptual scheme which I endorse is a scheme of connecting links and nothing more; by the use of mathematical symbolism everything non-essential to the expression of the linkage is removed. Dingle presumably does not

mean that science aims at discovering false or non-existent linkages. Then where is the difference between his view that science (when it achieves its aim) discovers true linkages and my view that the linkages so discovered are true? Further, we both argue that the conceptual scheme of physics does not comprise the whole truth about experience.

He makes a further attempt to establish a difference in Chapter VII; but that is only justified by taking my remarks about exact science and physical science to be applicable to science generally. My "elephant problem" is discussed by him at length, but the reader is not told that it was given as an illustration of the kind of knowledge handled in exact science. Since the qualifying word "exact" is ignored even when it is flaunted in headlines, I cannot feel very guilty of having misled Professor Dingle in a later passage where it was left to be inferred from the context.

Professor Dingle has much to say about the method of hypothesis which he contrasts with the method of abstraction. Having defined the word hypothesis so as to apply to any conclusion not deducible from observation, it is surely paradoxical that he should regard the relativity theory as the extremity of abstraction and the quantum theory as the extremity of hypothesis; for the close contact of the latter with observation and the comparative detachment of the former is notorious. Why are the electrons counted one by one in a Geiger counter deemed to be more hypothetical than the stars counted one by one on a photographic plate? Hypothetical properties may be ascribed to electrons as they may be ascribed to stars; but the electrons have the advantage in that every property assigned



Elliott & Fry.

SIR ARTHUR EDDINGTON.

* *Science and Human Experience.* By HERBERT DINGLE. (Williams & Norgate. 6s.).

in modern physics can be checked by observation. When it is discovered that an unverifiable property such as position *cum* velocity has been inadvertently assigned, it is at once discarded. For this reason I regard as altogether misleading the sketch of the growth of hypotheses on page 44, which starts with Newton's *Hypotheses non fingo* and leads through Laplace's apology for what appears to have been a particularly rash conjecture up to a quotation from the present writer. This last makes no reference to hypothetical mechanisms or explanations and speaks only of the mathematical equations of physics. The comparison of Laplace's statement with the writer's seems intended to suggest that our acceptance of hypotheses has become more assured and dogmatic. But the quotations refer to different questions, Laplace's being "What is true?" and mine "Where is Truth?"

Professor Dingle seems determined to discover in the modern physicist an attitude of omniscience, which is surely contrary to fact. "The rule of excluding inaccessibles . . . supposes a kind of omniscience in us, by which the physical world is necessarily composed of that which with our present

knowledge and means of observation we can conceivably detect." Not at all. It is only the man who thinks himself nearly omniscient who would publish a list of the things which (it occurs to him) might exist without his knowing it. Nor do we "act on the assumption that they do not exist"; so long as they are inaccessible the question of assuming their existence or non-existence cannot arise.

Dingle's account of the Principle of Uncertainty is clear, and unlike most determinists he appreciates its far-reaching epistemological significance. On page 86 he states his belief in physical determination, but I have been unable anywhere to discover his reasons. So far as I can see, all he has to adduce in its favour is that it is a hypothesis which no one has proved to be false. Is there any other hypothesis that has ever been accepted on that ground? In spite of pre-occupation with defensive preparation, I found time to applaud his remark that "Occam's razor is not a safety razor." There are often sound reasons for not multiplying entities beyond necessity, but those who flourish the razor are inclined to mistake mediaeval dogma for argument.

New Light on The Bible.

THE discovery of manuscripts providing "the most remarkable addition to the textual material of the Greek Bible" that has been made for ninety years was announced last month by Sir Frederic Kenyon. The material is the property of Mr. A. Chester Beatty, the well-known art collector, and evidently came from the library of a Christian church or monastery in Egypt. Writing in *The Times*, Sir Frederic explains that nineteen books of the Bible are represented, besides a substantial portion of a lost text of the Apocrypha.

There are some 190 leaves, among them the earliest manuscripts of the Greek Bible yet known, which date from the second century. All of them are "codices," *i.e.*, written in quires and not on rolls which were the usual form until about the fourth century. Christians used the codex before the pagans, but the new discovery carries it to an earlier date than has previously been known. Nor is this all. Hitherto the available evidence has suggested that the four gospels cannot have existed as a single volume before the fourth century, as the rolls were only of sufficient length for a single gospel. The new manuscript contains all four Gospels and the Acts also.

Sir Frederic Kenyon states that the Daniel papyrus

is one of the most interesting and valuable of the whole collection. As is well known, the original Septuagint version of this book fell into disfavour and was superseded by another translation, made by Theodotion in the second century after Christ. Of the original translation only one copy has hitherto been known, which is preserved in a manuscript probably of the eleventh century in the Chigi Library in Rome. The discovery of another and far earlier copy of a substantial portion of the book in this version is therefore a matter of considerable interest.

The greatest novelty of the whole collection is a substantial portion of the original Greek text of the apocryphal Book of Enoch. This is probably the most important of the non-canonical apocalyptic books, and has the special interest of being quoted in the Epistle of St. Jude, but until about forty years ago it was known only in an Ethiopic version. In 1892, however, the Greek text of the first thirty-five chapters was published by Bouriant from a vellum manuscript discovered in Egypt, which also contained the still more interesting texts of portions of the Gospel and Apocalypse of Peter. To these the Chester Beatty discovery adds a considerable fraction of the later part of the book.

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The Discovery of Element 87.

By A. S. Russell, D.Sc.

Interesting problems are raised by the discovery of a new element briefly reported in our last issue. To many workers in radio-activity it comes as a blow, upsetting present theories on this subject. Possibly the element is identical with hibernium which was discovered by Professor Joly in 1916.

THE isolation of a new element has always appealed to the popular mind and given to the scientist himself a more than ordinary thrill of discovery. A new element, if you think of it, is a fact not only in our own little planet but throughout the universe; a fact, indeed, for all time and for all space. The admirable work of Harry Moseley a few years before the war showed the element-finder for the first time exactly what task still lay before him; it showed that between the very heaviest and the very lightest known elements there were still six awaiting discovery. Naturally there has been a rush in the past decade to find these, and quite a lot of human nature has crept into science in this rush.

The first of the six to be found occasioned a row between investigators in Copenhagen and Paris and a dispute as to whether it should be called "hafnium" or "celtium."—a very stimulating and even healthy row that showed that the disinterested love of truth for its own sake could be mingled with a love for priority of discovery and a pretty taste in polemics. The second and third of the missing elements, "masurium" and "rhenium" were claimed alike by Berlin and Prague. The fourth, "illinium," announced from Urbana, Illinois, about two years ago, was found to be known as "florentium" by a few Italians as far back as 1923. This left two only, numbers 85 and 87, and the realization that as soon as these were found element-finding must for ever cease on this earth.

The most recent claim to have discovered element 87, known as "eka-caesium," has attracted more attention in the Press

and a more favourable reception by men of science than have earlier ones. Dr. Papish, an assistant professor at Cornell, and his co-worker Mr. Wainer, have identified this new element by an X-ray examination of a preparation obtained from the rare mineral samarskite. The claim, however, is not the first. From time to time I have read in various journals of claims to have found both elements 85 and 87, but nothing further about them seems to have happened. Recently at the Alabama Polytechnic Institute in the United States work has been proceeding on missing elements by a new "magneto-optical" device, and last year the investigators there thought they had found element 87 and this year element 85. I am told that Dr. Papish was for part of the time one of this team, but that he dissociated himself from the results obtained and, as far as one can learn, rightly. He is known to be a cautious worker, critical of all he himself does, and without the sanguine temperament which thinks a mere hint of a thing is adequate proof of it. His high reputation and the good credit of the *Journal of the American Chemical Society*, in which the discovery was briefly announced, encourage one to feel that the element has been discovered.

Certainly obtaining the X-ray spectral lines is the finest proof that we know of the existence of an element.

These lines are unique in the sense that no two elements give the same lines, and their positions in the spectrum are unequivocally known, even for an unknown element, before any work has begun. If, therefore, Dr. Papish and his colleague are not confusing the lines they have found with some secondary lines coming from



CORNELL UNIVERSITY.

It is here that the new element has been identified by Dr. Papish and his colleague.

known elements, there can be no doubt that they have got the new element. They have not yet isolated or purified it; that, however, does not matter; X-ray lines identify an element even when greatly contaminated with other elements.

To many workers in radio-activity, especially on the chemical side, this new discovery comes as a blow. It is generally accepted in physics that between the lightest of elements, hydrogen, and the heaviest yet found on earth, uranium, there can be only ninety others, making ninety-two in all. An element lighter than hydrogen is regarded as impossible. Elements heavier than uranium are regarded as being far too unstable ever to have persisted into our epoch, and there is a considerable body of evidence on the stability of elements which suggests strongly that elements 85 and 87 partake of the character of these very heavy hypothetical elements. There seems to have been no hint of an opposite suggestion, though, of course, this is not proof. According to Dr. Papish the new element, if radio-active at all, is only mildly so, and this to many of us is the surprising result. We have regarded both elements 85 and 87 as so excessively radio-active that if ever they arrived from the sun with the rest of the matter which composed our earth, they must long ago have entirely disappeared. If, however, they are but mildly radio-active, the argument for their non-existence goes. It is clear that the question must be left open for some time yet. In view of the fact that previous claims have failed to make good, there is no harm in our inclining a little to the sceptical side. But we can say that the evidence given this time is of much better character than that afforded by earlier claimants. As the United States has not taken a conspicuous place in the great game of element-finding in the past, we must hope as sportsmen that Dr. Papish is right.

New Points of Interest.

After a new element has been named and the usual row as to who really first discovered it is settled, some investigator unselfishly takes on the pedestrian task of discovering its properties; when these are announced interest in the element quickly drops. Who is violently interested now in "rhenium" or "illinium"? Their properties are the kind of properties the chemist knew they would have before they were found. The Periodic System of Classification of the Elements has furnished him with the weapon of accurate prediction of these properties, and prediction has bred in him if not contempt, at least a measure of indifference. Element 87, however, furnishes two

new points of interest. On the chemical side it is expected to be the most reactive metal in existence; that is to say, to possess in highest degree the most characteristic property of a metal—that of combining with other elements—a position hitherto held by caesium, a metal akin in nature to sodium and potassium. Of greater interest still is the nature and amount of the new element's radio-activity. Very little is known of the radio-activity of elements of odd atomic number, of which element 87 is one, and what comes to light may be of importance to our knowledge of the structure of very heavy atoms.

Some Problems.

When the element was first announced it was stated in the Press that its discovery had helped to solve the vexed question of the radio-activity of the common and light element potassium. There is, however, no truth in this suggestion. It is very strange indeed that a light element like potassium should have a property which, at one time, was thought to be confined to the very heaviest elements only, but there is no denying now that the property is genuine. To suggest that potassium owes its radio-activity to element 87 is to suggest that chemists are such poor analysts that they cannot purify potassium from other elements, known or unknown, which might be associated with it, even from such a one as element 87 which is predicted to be very similar to it in general chemical character. But potassium, wherever it is found—on the earth, in the sea, in a visitor from outside like a meteorite—has been proved to have the same amount of radio-activity per unit of mass; it could not be invariably contaminated with the same proportion of element 87. Further, Professor G. von Hevesy, of Freiburg in Breisgau, has found good evidence that the radio-activity is specific for one of the two kinds of atoms of which potassium is known to be composed. Potassium is a mixture of two chemically similar atoms of different masses, 39 and 41 on the ordinary scale. It is probably that the radio-activity is confined to the heavier and rarer form.

Is element 87 of 1931 Professor Joly's "hibernium" of 1916? About fifteen years ago Professor Joly found evidence of a radio-active character of a new, very mildly radio-active, element, that has never since been certainly identified with anything known. (It has been suggested that hibernium is a new radio-active form of lead, but no proof of this has been forthcoming.) Discussion of this intriguing question would lead us too far afield and in any case would be highly speculative. The answer may very safely be left to the future.

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*Bülów's Memoirs.—I.***A Chancellor's Defence.**

By R. B. Mowat.

Professor of History in the University of Bristol.

New and intimate light is thrown on the events of his time by Prince von Bülow in his "Memoirs." The dissatisfaction of a man who was not equal to the task of statesmanship which he had undertaken is clearly reflected, and this copious autobiography is here described as the defence of a man who knew that he had failed.

THE German Empire lasted for thirty-seven years and nine months, and had three emperors and eight chancellors. The emperors were William I, Frederick III, and William II. Frederick, who reigned only for three months in 1888, was the first of his name, but took the title *Frederick the Third*, as coming after the famous Holy Roman Emperor, Frederick II (1220-1250) and also the celebrated Frederick II, the Great, King of Prussia (1740-1786). The eight chancellors were Bismarck, Caprivi, Hohenlohe, Bülow, Bethmann-Hollweg, Michaelis, Hertling, and Prince Max of Baden; only the first five of these had long terms of service, the last three being chancellors in the two concluding years of the World War.

Early Years.

Prince Bülow was the fourth Chancellor of the German Empire from 1901 to 1909, but his public career was much longer. He was extremely well-connected, much more than the Bismarck family, though not with such exalted relationships as the Hohens. His family produced eminent generals in the Napoleonic War and World War. His great-uncle was Secretary of State and Minister of Foreign Affairs under Frederick William IV. His father was Secretary of State under William I, and was a valued colleague of Bismarck from 1873 to his death in 1879. The young Bülow, who was born in 1849, was educated at the gymnasium of Frankfurt, where his father was representative of the King of Denmark at the German Diet; later at Neustrelitz, where his father had gone as Prime Minister to the Duke of Mecklenburg-Strelitz; and finally at the Universities of Leipzig, Berlin and Lausanne. He fought as an hussar in the Franco-German War. It was after this that his father took service under Bismarck.

The young Bülow began his official career in the law courts at Metz, but in 1874 entered the German diplomatic service and joined the embassy at Rome as an attaché. He served subsequently at St.

Petersburg and Bucharest, and in 1894 was appointed ambassador at Rome. His wife was the daughter of Donna Laura Minghetti by her first marriage with Prince Camporeale. Donna Laura's second husband was Marco Minghetti, who was twice Prime Minister of Italy. Bülow, therefore, by reason of his wife's high Italian connexions, as well as by reason of his own social and literary accomplishments, had a rather remarkable position in Roman society.

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Acute Controversy.

Only the first two volumes have, so far, been published in the handsomely produced and extremely well-rendered English version.* It is, naturally, over the contents of the first two volumes that the fires of controversy have raged, that is, over the "Bülow era," beginning with his appointment as Secretary of State and Minister for Foreign Affairs in June, 1897.

* *Prince von Bülow: Memoirs.* 1897-1903 and 1903-1909. Translated by F. A. VOIGT. (Putnam. 25s. each.)

known elements, there can be no doubt that they have got the new element. They have not yet isolated or purified it; that, however, does not matter; X-ray lines identify an element even when greatly contaminated with other elements.

To many workers in radio-activity, especially on the chemical side, this new discovery comes as a blow. It is generally accepted in physics that between the lightest of elements, hydrogen, and the heaviest yet found on earth, uranium, there can be only ninety others, making ninety-two in all. An element lighter than hydrogen is regarded as impossible. Elements heavier than uranium are regarded as being far too unstable ever to have persisted into our epoch, and there is a considerable body of evidence on the stability of elements which suggests strongly that elements 85 and 87 partake of the character of these very heavy hypothetical elements. There seems to have been no hint of an opposite suggestion, though, of course, this is not proof. According to Dr. Papish the new element, if radio-active at all, is only mildly so, and this to many of us is the surprising result. We have regarded both elements 85 and 87 as so excessively radio-active that if ever they arrived from the sun with the rest of the matter which composed our earth, they must long ago have entirely disappeared. If, however, they are but mildly radio-active, the argument for their non-existence goes. It is clear that the question must be left open for some time yet. In view of the fact that previous claims have failed to make good, there is no harm in our inclining a little to the sceptical side. But we can say that the evidence given this time is of much better character than that afforded by earlier claimants. As the United States has not taken a conspicuous place in the great game of element-finding in the past, we must hope as sportsmen that Dr. Papish is right.

New Points of Interest.

After a new element has been named and the usual row as to who really first discovered it is settled, some investigator unselfishly takes on the pedestrian task of discovering its properties; when these are announced interest in the element quickly drops. Who is violently interested now in "rhenium" or "illinium"? Their properties are the kind of properties the chemist knew they would have before they were found. The Periodic System of Classification of the Elements has furnished him with the weapon of accurate prediction of these properties, and prediction has bred in him if not contempt, at least a measure of indifference. Element 87, however, furnishes two

new points of interest. On the chemical side it is expected to be the most reactive metal in existence; that is to say, to possess in highest degree the most characteristic property of a metal—that of combining with other elements—a position hitherto held by caesium, a metal akin in nature to sodium and potassium. Of greater interest still is the nature and amount of the new element's radio-activity. Very little is known of the radio-activity of elements of odd atomic number, of which element 87 is one, and what comes to light may be of importance to our knowledge of the structure of very heavy atoms.

Some Problems.

When the element was first announced it was stated in the Press that its discovery had helped to solve the vexed question of the radio-activity of the common and light element potassium. There is, however, no truth in this suggestion. It is very strange indeed that a light element like potassium should have a property which, at one time, was thought to be confined to the very heaviest elements only, but there is no denying now that the property is genuine. To suggest that potassium owes its radio-activity to element 87 is to suggest that chemists are such poor analysts that they cannot purify potassium from other elements, known or unknown, which might be associated with it, even from such a one as element 87 which is predicted to be very similar to it in general chemical character. But potassium, wherever it is found—on the earth, in the sea, in a visitor from outside like a meteorite—has been proved to have the same amount of radio-activity per unit of mass; it could not be invariably contaminated with the same proportion of element 87. Further, Professor G. von Hevesy, of Freiburg in Breisgau, has found good evidence that the radio-activity is specific for one of the two kinds of atoms of which potassium is known to be composed. Potassium is a mixture of two chemically similar atoms of different masses, 39 and 41 on the ordinary scale. It is probably that the radio-activity is confined to the heavier and rarer form.

Is element 87 of 1931 Professor Joly's "hibernium" of 1916? About fifteen years ago Professor Joly found evidence of a radio-active character of a new, very mildly radio-active, element, that has never since been certainly identified with anything known. (It has been suggested that hibernium is a new radio-active form of lead, but no proof of this has been forthcoming.) Discussion of this intriguing question would lead us too far afield and in any case would be highly speculative. The answer may very safely be left to the future.

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*Bülow's Memoirs.—I.***A Chancellor's Defence.**

By R. B. Mowat.

Professor of History in the University of Bristol.

New and intimate light is thrown on the events of his time by Prince von Bülow in his "Memoirs." The dissatisfaction of a man who was not equal to the task of statesmanship which he had undertaken is clearly reflected, and this copious autobiography is here described as the defence of a man who knew that he had failed.

THE German Empire lasted for thirty-seven years and nine months, and had three emperors and eight chancellors. The emperors were William I, Frederick III, and William II. Frederick, who reigned only for three months in 1888, was the first of his name, but took the title *Frederick the Third*, as coming after the famous Holy Roman Emperor, Frederick II (1220-1250) and also the celebrated Frederick II, the Great, King of Prussia (1740-1786). The eight chancellors were Bismarck, Caprivi, Hohenlohe, Bülow, Bethmann-Hollweg, Michaelis, Hertling, and Prince Max of Baden; only the first five of these had long terms of service, the last three being chancellors in the two concluding years of the World War.

Early Years.

Prince Bülow was the fourth Chancellor of the German Empire from 1901 to 1909, but his public career was much longer. He was extremely well-connected, much more than the Bismarck family, though not with such exalted relationships as the Hohenlohes. His family produced eminent generals in the Napoleonic War and World War. His great-uncle was Secretary of State and Minister of Foreign Affairs under Frederick William IV. His father was Secretary of State under William I, and was a valued colleague of Bismarck from 1873 to his death in 1879. The young Bülow, who was born in 1849, was educated at the gymnasium of Frankfurt, where his father was representative of the King of Denmark at the German Diet; later at Neustrelitz, where his father had gone as Prime Minister to the Duke of Mecklenburg-Strelitz; and finally at the Universities of Leipzig, Berlin and Lausanne. He fought as an hussar in the Franco-German War. It was after this that his father took service under Bismarck.

The young Bülow began his official career in the law courts at Metz, but in 1874 entered the German diplomatic service and joined the embassy at Rome as an attaché. He served subsequently at St.

Petersburg and Bucharest, and in 1894 was appointed ambassador at Rome. His wife was the daughter of Donna Laura Minghetti by her first marriage with Prince Camporeale. Donna Laura's second husband was Marco Minghetti, who was twice Prime Minister of Italy. Bülow, therefore, by reason of his wife's high Italian connexions, as well as by reason of his own social and literary accomplishments, had a rather remarkable position in Roman society.

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Bülow left Rome with regret, for there he had precisely the artistic and literary society which he enjoyed and which, indeed, he greatly adorned along with his beautiful and accomplished wife. When he received the summoning telegram from Berlin at the Palazzo Caffarelli (at that time the German Embassy) he had "the feeling of a man on a walk who, having observed the clouds gathering in the sky for some time, and the lightning beginning to flash, suddenly finds himself caught in the bursting storm." It was under this impression that he entered upon this most momentous phase of his career, leading to the position of chancellor of that wonderful German Empire which commanded the attention of Europe and the world in the last part of the nineteenth century and the first part of the twentieth.

The value of Bülow's "Memoirs" must be judged with reference to the needs of the present age. It will be generally acknowledged that there is no greater need in the modern world than that the peoples of all countries should know about each other, and should understand their political, social and economic conditions. Fifty years ago this was not so necessary, for governments could manage foreign affairs without much interference from public opinion. To-day, however, everybody reads the newspapers and has views upon foreign affairs, and by means of the Press and through universal suffrage can and does very definitely influence policy. It is therefore of the highest importance that public opinion should be well informed on present and recent history. For this purpose memoirs, though often misleading, are of particular value.

Memoirs differ from other kinds of histories in so far as they only deal, or should only deal, with events in which the author has himself been concerned, or with people about whom he has personal knowledge. Thus memoirs are highly "subjective"; they give a purely personal interpretation. They are "first-hand," intimate, the result of vivid experience, but on this account necessarily partial, perhaps prejudiced, and in any case only reproducing the

circle (wide, yet very definitely limited) within the experience of one man.

Bülow's "Memoirs" are a brilliant, perhaps the most brilliant, production of this kind which has appeared in the last hundred years. Bülow was as clever and cynical as Talleyrand, as experienced in high politics as Bismarck; and his "Memoirs" certainly equal, if they do not surpass, the celebrated works which these two great statesmen put forth as their personal interpretation of their own time, and as their defence of their supremely long and influential careers. The publication is, accordingly, an event of first-class literary and historical importance.

Bülow's influence on the course of events was not really on the grand scale, like that of Talleyrand and Bismarck. He had a big part to play, but he himself was not cast in a great mould. His "Memoirs," which are the defence of his statesmanship, are the defence of a man who knew that he had really failed, and that he was in fact inferior to the big men—the Bismarcks, Salisburys, Metternichs, Talleyrands—of whom, by official position he was, as it were, the colleague. This sense of failure and inferiority gives two outstanding qualities to his "Memoirs": it gives him the perpetual pose of the wise men of the Greek

tragedy, who saw the mistakes that everybody was making and the fate that they were rushing upon; and it makes him spiteful and malicious, the more so because it is all done with such refined touches, in such an Olympian and *negligé* manner.

So possessed was he with the purpose of showing that he alone always saw clear, and also of putting his stiletto into the reputations of all his contemporaries, that he spent five years in carefully and elaborately dictating the "Memoirs," and then three more in revising them, and finally made the condition that they should only be published after his death. Thus the spoiled child of fortune, who seems to have had every gift and good quality except magnanimity and complete sincerity, elaborately staged the end



PRINCE VON BÜLOW.

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Bülow's "Memoirs," by reason of their massive size, their astonishing and ever delightful literary piquancy, their mordant cynicism, and their personal intimacies with high events and people, are easily supreme in the crowd of memoirs which have appeared since the World War. While Poincaré and Grey have written what are simply statesmenlike expositions of their policy, Bülow has caught and painted in all its vivid colouring that aristocratic world of high politics and high society which survived the French Revolution and Napoleonic Wars and the national and democratic movements of the nineteenth century, but which has vanished with the World War and the German, Austrian and Russian revolutions. There are perhaps only three other post-war books which in respect of this kind of knowledge can be compared with Bülow's; these are Haller's "Philip von Eulenburg," Sir Rennell Rodd's "Social and Diplomatic Memories," and von Eckardstein's "Ten Years at the Court of St. James."

The curtain goes up on this varied stage with Bülow, after receiving his telegram of summons, and taking leave of the Italian Foreign Minister at Rome, going straight to Berlin by train, and putting up at the Kaiserhof (the expensive hotel which rich Germans frequented; foreigners went to the Adlon). Immediately after arrival, he went to the barber's, "to have the dust of the journey removed by a hair-cut and shampoo." This was a barber of princes, for the man in the white sheet next to Bülow turned out to be Prince Franz Arenberg, of one of the grand Roman-Catholic houses of South Germany.

The South Germans, nobility and bourgeoisie alike, always favoured the system of parliamentary, responsible government which the Imperial Government had persistently declined to introduce. Baron von Marschall, the Secretary of State whom Bülow was replacing, was a South German, and in favour of a measure of parliamentarianism; so Prince Arenberg

gave rather a "growling" greeting to Bülow who, however, managed to mollify him, and take him off to the Foreign Office where the preliminary calls were made on the mysterious Political Director, Holstein, the outgoing Secretary of State, Marschall, and the aged Chancellor Hohenlohe, the *doyen* of European statesmen.

From this point the narrative takes its course in a leisurely, but ample and comprehensive manner: a short cruise with Kaiser Wilhelm II on board the *Hohenzollern* from Kiel; luncheon with King Leopold II of Belgium, who tried to induce the Kaiser

to invest money in some of his dubious business enterprises in Africa, and whom the Kaiserin called "the horrible man"; a visit to the aged Bismarck at Friedrichsruh, a home that was Spartan and inartistic; pen-portraits of all the leading Berlin officials and high nobility, the men around the Kaiser; at St. Petersburg in the suite of Wilhelm II; military parades and grand manoeuvres; a momentous visit to England with the Kaiser in the middle of the Boer War; meetings with the King and Queen of Italy, with the Emperor Francis Joseph, the Archdukes, the Tsar, Muravieff, the Tsarina, the Sultan Abdul Hamid II. The tone of these sketches is nearly always humorous and bitter, the outlines

clear and sharp. The element of contrast is used. For instance:—

"William II loved display; he used, as already mentioned, to wear as many orders as he could. His self-esteem rose when he took a field-marshal's baton in his hand, or on shipboard the admiral's telescope which, on the high seas, replaces the marshal's baton. The Emperor Francis Joseph wore orders other than his own only when he had to receive or visit foreign sovereigns, and even these he wore only in miniature. I do not think he ever took a marshal's baton in his hand. The thought of having to wear full court hunting dress, top boots, spurs and feathered hat, which William II bestowed on all his friends and servants who loved hunting, would have filled him



BARON AERENTHAL.

Foreign Minister for the Habsburg Monarchy.

with horror. The Emperor Francis Joseph went to hunt in the same simple outfit as any Austrian sportsman. The German Kaiser's manner of speech was what the French call *saccadé*, jerky and abrupt. The Austrian Emperor's was sober, even monotonous, almost soporific."

Specimens of "the Austrian bent for humour, kindly and innocent humour," are given, not perhaps always innocently, in the description of Francis Joseph. "Even in his old age he rose very early, between four and five in the morning, and, in compensation, went to bed at night as early as possible, and never after nine o'clock if he could manage it. His Foreign Minister, Count Goluchowski, had exactly the opposite habits. He went to bed after midnight and so got up as late as he could in the forenoon. When he accompanied the Emperor on a journey to Roumania, the Emperor said to him with a smile: 'My dear Count, I know that you like to sleep on in the morning, so please don't trouble to bring reports to me at five; come about six.'

"A remark the Emperor made in 1866 (its authenticity was guaranteed to me) shows a grimmer humour. It was a hunting party. The Emperor, as was natural after a war which he had lost, was in a depressed mood. His adjutants thought that they might improve his Majesty's temper if they abused the Prussians and, of course, Bismarck in particular. One of them went too far by declaring that he knew from a sure source that Bismarck got drunk every day on *schnaps*. 'Heavens,' cried Francis Joseph, 'if my Ministers would only take to *schnaps*.' The Emperor Francis Joseph once summed himself up, as is well known: he thought, he said, that he would have made an excellent court official."

Austro-German Relations.

All this is very well, but there is, of course, far more in the book than agreeable and ill-natured chatter of the Court and Foreign Office, the diplomatic club and the *salon*. There is much information on matters of high policy; not indeed that secrets of State are to be discovered here. Indeed, it is doubtful whether many secrets of State still remain to be divulged. Bülow, however, has much to say about important historical episodes. The relations of Germany and Austria concerning Bosnia-Herzegovina and the Balkans may be taken as an example. Bülow sees in these relations the genesis of the World War. In general he deprecates what he calls "our tendency to refer the events and questions of the present to causes far too remote in the past." "This is all of a piece," he adds, "with the German tendency to

pedantry—to losing oneself in ever-increasing depths of speculation"; and he quotes a French satire on this German tendency: *sans Eve, et sans la pomme, point d'ultimatum, point de guerre*. Nevertheless, Bülow writes: "I will conclude this digression . . . by admitting that there are sometimes events which form the last link of a long chain." To such a chain belonged the Bosnian question.

Aerenthal's Coup.

The Bosnian question arose out of the Russo-Turkish War of 1877-78, and out of the Congress of Berlin in which Bülow, at that time a very young diplomatist, had been one of the secretaries. One of the results of the war and the Congress was that Austria-Hungary was authorized in the Treaty of Berlin to occupy and to administer the two Turkish provinces of Bosnia and Herzegovina. Austria-Hungary administered the provinces under a nominal Turkish suzerainty until 1908. In that year Baron Aerenthal, Minister of Foreign Affairs for the Habsburg Monarchy, brought off a remarkable diplomatic *coup*.

Aerenthal was the grandson of a Jewish grain merchant who had made a large fortune. On his grandmother's and mother's side he belonged to the high Austrian nobility. He was an intelligent, industrious diplomatist, cautious, yet (says Bülow) with a full share of the arrogance natural to the Austrian aristocracy. "Tall, broad-shouldered, a little bowed, very short-sighted, sometimes almost blind, with eyelids that always drooped and a look of weariness, but with regular features and an aristocratic air; reserved, rather indolent, almost apathetic, Aerenthal stood in utter contrast to the shorter, more restless and excitable, and occasionally pushing Calmuck, Isvolsky."

The story of the quarrel between Aerenthal and Isvolsky is well known; but Bülow's account of the German side of the affair adds something to our information. In the celebrated interview between Aerenthal and Isvolsky at Buchlau, Count Berchtold's castle, on 15th September, 1908, a verbal agreement was apparently reached to the effect that Austria and Russia should support each other over two things—the annexation of Bosnia-Herzegovina by Austria; the opening of the Dardanelles in favour of Russia. When the interview was over, Aerenthal at once proceeded to annex the two Turkish provinces, in defiance of the Treaty of Berlin.

Thus Aerenthal created an international crisis which made it quite impossible for Isvolsky to secure his object in regard to the Dardanelles. Isvolsky loudly protested that he had been duped by the Austrian

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Foreign Minister. Bülow's account is "that Aerenthal, who was the cleverer player, had the formal right on his side, but that his conduct was not quite 'fair,' to use an English expression which meets the case." It is a curious and significant fact that Bülow, while criticizing Aerenthal for over-reaching Isvolsky, says nothing whatever about his far greater fault in breaking the Treaty of Berlin. All that Bülow was anxious about was to retain the Austrian alliance without involving Germany in a European war. "We must not risk the loss of Austria-Hungary, with her fifty million inhabitants, her strong and efficient army, but still less must we let ourselves be dragged by her into the midst of an armed conflict which I was convinced would be very difficult to localize and might lead to a general war."

Undertones of War.

The Kaiser wanted to demand that Austria should withdraw the decree of annexation, but Bülow dissuaded him, for this would mean the loss of the Austrian alliance. "The Emperor could leave me to act as signalman. I trusted my skill and strength to set the points so that the Austrian express should not collide with the Russian." This is to say that Bülow undertook to enable Austria with impunity to break the Treaty of Berlin, to defy the other Powers who demanded a European conference, and to inflict a grave public rebuff upon Russia, while at the same time he promised the Kaiser that there should be no European war.

Bülow succeeded in all these aims, and prides himself on a skill which his successors of 1914, faced with a somewhat similar contingency, could not show. He does not see that his own story and defence really make him one of the authors of the war of 1914; for he was the means by which in 1908-1909 Austria inflicted a humiliation upon Russia—a thing which a Great Power will never allow to happen twice in quick succession. Therefore in 1914, when Austria again with Germany behind her, took to defying Russia over a Balkan, Slavonic question, Russia refused to give way. Bülow made Russia's attitude in 1914 certain.

So far Bülow's account of the Bosnian affair tallies with what is otherwise known of the facts, and is a frank enough account of his own policy. He goes out of his way, however, to say that King Edward VII used "his passion for political intrigues and gift for poisoning the well-springs of political relationships" to inflame the trouble. Now, the publication of the "British Documents on the Origins of the War" clearly show that King Edward, as a constitutional

monarch, had nothing to do with the directing of British policy; he read his ministers' dispatches, and made some, but very few, brief and sensible comments on these documents, and nothing more.

Another statement of Bülow shows how cautiously the historian must use these "Memoirs." Bülow writes that after Russia had yielded to the Austrians, that is, had acquiesced in the annexation of Bosnia-Herzegovina without receiving any satisfaction in regard to the Dardanelles in return, Nicolson was furious. Nicolson was British ambassador at St. Petersburg, and afterwards Under-Secretary of State for Foreign Affairs. Bülow writes: "Nicolson . . . vested his ill-temper and disappointment by spreading the lie that Germany had brought Russia to heel by threats, by a thrust of the 'mailed fist.'" Well, that is what the documents now show that Germany actually did. The documents obtained and published by Siebert since the War ("Diplomatische Aktenstücke zur Geschichte der Entente-politik") contain the following dispatch, directed by the German Government to Count Pourtales, German ambassador at St. Petersburg, and dated 21st March, 1909:—

"We must know in definite terms whether Russia accepts the Austro-Hungarian note and gives her formal and unreserved consent to the abrogation of Article 25 of the Treaty of Berlin. Your Excellency will kindly make it clear to M. Isvolsky that we expect a definite answer: yes or no. An evasive, conditional or vague reply we shall regard as a refusal. And thereupon we shall withdraw and allow things to take their course."

The Bosnian Crisis.

Faced with this demand, which practically amounted to an ultimatum from Germany, the Russian Government decided to give way to Austria, and all Europe was witness to the check. Russian prestige suffered; Russia drew back in the dispute with Austria in the face of a German threat—but never again would she do so. "Bilof," said the Austrian Emperor (who spoke German in the Viennese way), "managed that affair (the Bosnian crisis) very well." As a matter of fact he managed it in such a way as to make a future European war, if ever another Austro-Russian controversy arose over the Balkans, infinitely more difficult to avoid. He gained a diplomatic success at the expense of the next generation.

A Roumanian diplomatist once said to Bülow that the Bosnian question was a Pandora's box, full of surprises, perils and grave possibilities. The greatest peril which it was to produce came in 1914.

(To be continued.)

The Cinema in Science.

By R. Neil Chrystal, D.Sc.

Imperial Forestry Institute, Oxford.

A hitherto unexplored field is opened up by the introduction of the film as an aid to scientific research. The cinema has already proved its value on the educational side and some striking nature films have been made.

To realize the mechanistic development of cinematography during the past twenty-five years one need only have paid a brief visit to the recent Mechanical Aids to Learning Exhibition, where all the most advanced forms of talking film equipment were displayed. Cinematography to-day portrays all forms of human activity; its future as a new form of pictorial dramatic art has boundless possibilities and will open up new fields of experiment with fresh and improved technique.

The Film in Education.

The value of the film in education is gradually becoming more widely recognized, and plans for its development are now being discussed in conjunction with practical experiment. Already history, geography and other subjects are being taught in some schools with the aid of film illustrations, and the question which it is proposed to discuss here is how far the film can be applied in the service of scientific education and for the furtherance of research. The question is one of great importance, and to derive the fullest value from the use of films as a method of education will require careful consideration, while their use in research opens up a field of enquiry which is so far practically unexplored.

Many people look upon the introduction of mechanical methods into scientific education with grave mistrust. This attitude is justifiable, if the method is to be used as the sole means to the end in view. Scientific work—and especially the study of the biological sciences, which have much to gain from an intelligent use of the film—demands as its foundation practical work on the living organism in the laboratory, coupled with field studies of animals and plants in their natural environment. In the words of Huxley, "a first-hand knowledge of the facts, be they few or many" is the chief desideratum. Laboratory work must, however, be expanded by the use of textbooks, diagrams and lantern slides, and it is precisely at this point and in conjunction with these that we believe the film of the future is destined to play an important part.

A few concrete examples will illustrate the point. Suppose, for instance, that the student has been studying in the laboratory such subjects as seedling germination, insect metamorphosis, or the habits of climbing plants. Practical work has given him a first-hand knowledge of the structure and mechanism of the organism concerned; field observations have shown him something of their life under natural conditions; while from the textbook he has gleaned a mass of detail some of which he has probably observed for himself. Notes, and especially drawings of the various organisms studied are duly made, and the student gradually learns the art of observation, proficiency in which will depend upon the amount of natural talent which he possesses. The best observers are sometimes said to be born, not made. Now, if the student's work ceases at this point we may find that it is in a sense disconnected, that is to say, he has not seen the biology of any particular organism enacted as a living drama before his eyes. Laboratory work makes up in part for this deficiency, but laboratory studies on living things take time, sometimes a long time, and quite often only a portion of the story is unfolded during the period which the student has at his disposal.

Living Pictures.

Suppose, however, that we add to the student's equipment the study of film records depicting the biology of these organisms, the salient features of which are carefully explained to him by a competent instructor, would this not serve to implant the facts in his mind, to bring an unforgettable living picture of the organism before him, and, finally, enable him to view it as a living whole? This we believe the film can do, and it is in this way that its most valuable work can be performed. In a recent article on "The Rôle of the Cinema in Biology," written for the Eton College Natural History Society, the compilation of a "film textbook" of natural history was put forward as an ideal to be aimed at. Studies of insect life were then under consideration, but the idea can, and indeed should, be extended to embrace all forms

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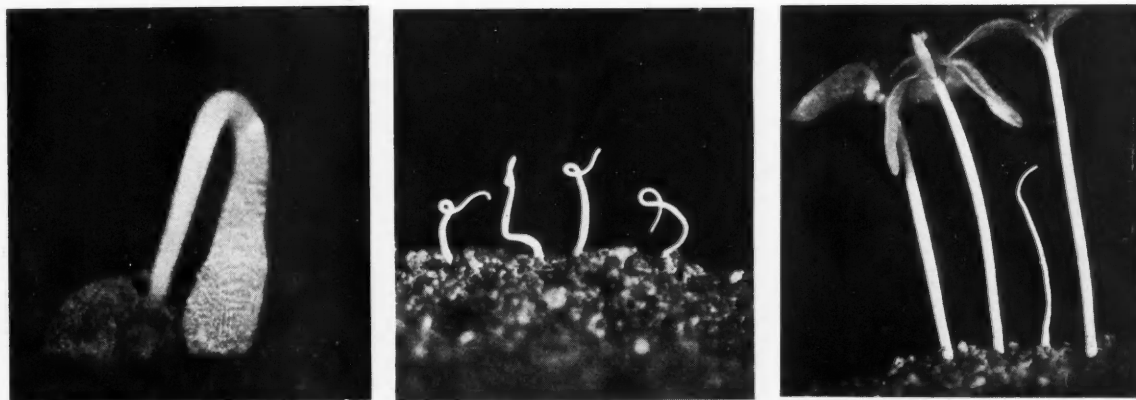
of animal and plant life. Work of this kind would be of the greatest value and importance. So far, natural history films have been the work of single individuals such as Captain Knight, with his studies of the golden eagle, Mr. Cherry Kearton with his penguin film, the "Epic" films of Indian and African jungle life which in their wide scope give the spectator a wonderful ecological picture of the wild life of these continents, or the work of commercial organizations such as British Instructional Films, Ltd., whose "Secrets of Nature" series blazes a pioneer trail.

This series embraces a wide range of subjects and the policy followed thus far has been to produce a short film, lasting from twelve to fifteen minutes, which could be interpolated as a "short" to fill up a theatre programme. These films are edited for popular consumption, and their titles are made sensational with the object of capturing the imagination of the audience. Thus, a remarkable camera study of fungi bears the title "Plant-Life of the Underworld," the pictorial record of the parasitic dodder plant is concealed under the title "The Strangler," while the life story of the gnat, one of the most beautiful studies of all, masquerades under the title "Phantoms." The camera work of these productions must be regarded as quite the most remarkable ever produced, and for this the company is indebted to the work of Mr. Percy Smith, whose talent for this type of work is outstanding.

Having seen all these films and in addition one other dealing with the Myxomycetes or slime fungi, I am of the opinion that in all cases the talking commentary which accompanies the film is not the most suitable for strictly educational purposes. The fantastic titles now given to these films should be discarded for

simpler and more scientific ones. Plain statement of fact should be substituted for the rather fanciful type of discourse now presented, while in certain parts of the film more definite scientific explanations of the phenomena in progress should be added even though this entailed lengthening the film text. One example of this kind was particularly evident in the Myxomycete film, where a striking picture of amoeboid movement was shown, the explanation of which was insufficient. It is probable also that portions of film hitherto omitted for popular presentation could be inserted for use in teaching. This criticism is by no means intended to belittle the magnificent work which is being done in the production of popular natural history films. On the contrary the films already made have shown the enormous possibilities of the camera as applied to the study of living organisms. Teachers and others should be induced to use these films as a definite part of scientific education, and this can be accomplished if the changes suggested above are carried out.

In January, 1930, the Imperial Forestry Institute of Oxford decided that a film should be made of the *Sirex* woodwasps and their parasites, a study of woodborers and the parasitic insects which attack and kill their grubs. A very complete pictorial record of the insect's biology was made, the total length running to some 2,800 feet. This film was an initial experiment in the production of a scientific record of an insect's biology, and several valuable lessons were learned as a result of the experience. The most important of these was the realization that in the film we have an instrument which can preserve for us a living picture, accurate in all its details, of an organism's behaviour at a given period of its life,



SCENES FROM "THE STRANGLER" FILM

Left.—The dodder seedling germinating. Centre.—The young dodders reaching out in search of a host. Right.—A young dodder about to entwine round a bean seedling.

and that this can be demonstrated to others at times and seasons when to seek a performance of the phenomena under natural conditions would be impossible. The inherent possibilities of the film were also very obvious, but the opportunity was lacking for full use to be made of all of these. A popular version of this film entitled "Warfare in the Trees" has now been made. This, of course, is not only very much shorter than the original but differs considerably in the manner in which the subject is presented.

For educational purposes the film in this form is, I think, altogether too brief and does not contain all the detail necessary for the original purpose for which it was produced. But as a popular study of the woodwasp and its major parasite, *Rhyssa*, the film is in its essentials admirable. Technique has reached such a stage that, within limits, the size of the organism dealt with is immaterial. Studies of protozoa and other minute forms of life have been successfully made, and in the case of the woodwasp film, the egg of a parasite was photographed under the microscope and the hatching of the young grub demonstrated, while other more recondite studies of the organisms concerned could have been made had opportunity offered. The "time lapse" camera device, by which pictures of living organisms can be taken at definitely fixed intervals of time, enables such film records to be made, and this technique is employed in the production of most films of this type.

The important thing to remember in this case is that the actual making of the film was preceded by research work in the field and laboratory over a period of several years, in which the experience gained was all-important when the construction of the film was begun. After the film was completed the question of making a talking picture was mooted. This was the first scientific film of its kind to be synchronized with the running commentary, and it was soon discovered that the making of a talking picture was by no means a simple matter, as the speed at which the film was running, ninety feet per minute, made

it necessary that statements should be brief. It was found in some cases, for example, that the amount of film available for the explanation necessary was not sufficient, while in others there was an excess of film, the whole effect being somewhat unbalanced. To ensure the best results, therefore, such a film must be carefully spaced out at the start and put together so that each episode covers a length of film sufficient to carry the requisite amount of speech, and to obtain perfect synchronization. Otherwise it may happen that the film runs ahead of the descriptive matter and that important details have to be omitted in order that co-ordination may be effected.

The talking film has, of course, come to stay, and the new portable projectors, of which at least three

new types were shown at the recent exhibition, will, once their cost has come within range of practical school finance, take their place in most schools with the epidiascope and other modern classroom equipment. A good talking film is, of course, ideal, especially where the film is sent far and wide, and the subject dealt with needs expert handling. In many cases, however, it may be that the talking picture is not indispensable; indeed, the ideal way to utilize the film would appear to be a preliminary lesson or discussion with the aid of



EGG-LAYING OF A WOODWASP PARASITE.

Ithalia leucospoides, a parasite of the siren woodwasp, ovipositing down an egg-shaft. The blade-like sheath guides the egg tube down the shaft. The eggs are laid inside the young grubs of the woodwasp.

still pictures or specimens, followed by the film of the living creature, a method which has been used on several occasions in presenting the woodwasp film and has met with excellent results. Certainly more detail can be dealt with in this way which in the case of a talking film would have to be omitted altogether. The production of scientific films has not so far been taken up by any university or similar institution in this country. A start has been made in the U.S.A., and some day we hope scientific films will be made under the direction of universities as a definite part of their activities. This would surely lead to further experiments in the production of more detailed film studies, the talking versions of which would be the work of experts.

Although the film can hardly be said to have advanced very far in the direction of scientific research,

some initial experiments have been made and the future holds out promise of distinct possibilities. One of the most interesting recent examples of the employment of the film in research work was the plant virus film shown at the British Association meeting in London, by Dr. F. M. L. Sheffield, under the title "Cytological Aspects of Virus Diseases in Plants." The study of the ultra-microscopic virus organisms which cause diseases in plants such as "tobacco mosaic," for example, has now developed into a separate branch of research on its own. The film in question was made at the Rothamsted Experimental Station, Harpenden, and Mr. Percy Smith of British Instructional Films was responsible for the photography. The film demonstrated the formation of certain abnormal bodies in the cytoplasm of the plant cells affected by the virus, and their behaviour over a continuous period of time. It provided an interesting record, and the hope was expressed that further films of this kind might prove useful in furthering the progress of the research.

Film records have already been made during the past few years on microscopic subjects of a similar nature. Thus a very successful film study of tissue culture work has been carried out, and also a study of the action of cilia in micro-organisms and a biological study of protozoan parasites. This certainly suggests that a more extensive use of the film may be made in cytological and pathological research.

In the case of larger organisms, the observational powers of the camera have already proved valuable in drawing public attention to phenomena which are either new or have been in the past only imperfectly observed. It is already well known to many that the slow motion studies of bird flight have a definite research value in their relation to aeronautical problems. Further in this connexion, slow motion studies of fish in relation to their aquatic medium have placed valuable data in the hands of ship designers, as some films made a few years ago in Germany give evidence. I note also that a slow

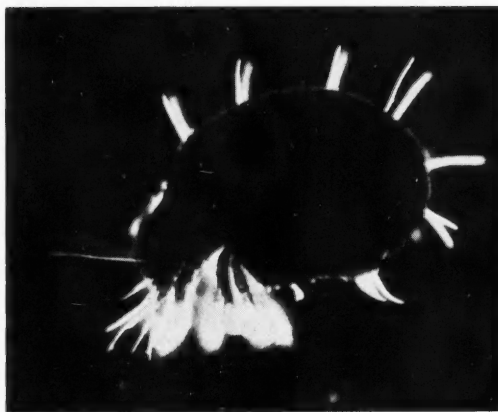
motion study of fertilization in flowers is being prepared. This film should be particularly interesting as affording us an opportunity of studying the value of the observations gained by such a detailed method.

Inasmuch as we can slow down the rate of motion of the film at will, so also can we speed it up to any given rate we please. The numerical data which can thus be obtained by direct calculation regarding the rate of growth of an organism, the development of which has been filmed in its entirety, are only too obvious, and were such studies combined with definitely controlled environments—for instance, in the case of plants or soil types—the results to be gained might be very valuable. Finally, it is not impossible that careful study by experts of some of

the "Secrets of Nature" films may reveal aspects of behaviour hitherto overlooked, or settle some point of detail which has been a matter of dispute. In this connexion a recent letter from Mr. Percy Smith is interesting. Writing of his film, "Plant-Life of the Underworld," he states that only those portions of the film were used which could be put together to form a convincing and readily comprehensible story for the public. Other portions of the film had to be left out for the reason that the movements of the fungus could not be

easily interpreted, and it is quite likely that those portions might have had great interest for the specialist. This again suggests that a film apparatus should form part of the normal equipment of any research station so that films could be made under controlled conditions and the results obtained critically analysed.

The conclusions may now be summed up in a few sentences. We have in the cinema film a powerful instrument for education, but it is only an auxiliary in the teaching of science and can never replace fundamental studies. It is a mechanical method and should never engender mechanical methods of thought and action. As to its value in the furtherance of scientific research the cinema is a new technique in science, the scope and possibilities of which are at present almost untried.



STUDY OF A MITE.

An unusual "shot" from a zoological film in the *Secrets of Nature* series, produced by British Instructional Films, Ltd. The camera work of these studies must be regarded as the most remarkable ever produced.

Is There a Cure for Wireless Confusion ?

(Specially Contributed).

The most difficult problem at present facing broadcasting authorities is the confusion in the ether which causes interference in reception from different stations. In discussing a solution of the problem, the author suggests that listeners would encounter less trouble if they were content with a smaller choice of programmes.

"CONFUSION in the Ether" has been a favourite heading in the daily Press during the last few weeks and has often been followed by some confusion in words. It may be useful, therefore, to consider what really is meant by confusion in the ether, and how it may possibly become less, instead of more, confounded; for at present it is becoming more confounded every day, or rather night.

The confusion referred to in the newspapers is that which occurs in the broadcasting service. It is this service which is here considered, but it need not be supposed that all the other wireless services are immune from similar troubles. They are not; and each one of them considers its own troubles to be as great and as important as those which beset the broadcasting authorities. It may indeed be so, but broadcasting provides enjoyment for millions, and if its troubles are not greater or more important, their effect is certainly far more widespread, and therefore of more general concern.

The troubles referred to result in the programmes from one station being interfered with at the listener's end by programmes from other stations, and how to prevent this interference is the greatest technical difficulty presented to the broadcasting authorities of the world. In Europe, the problem is obviously very difficult to deal with owing to the great diversity in controlling authorities. Each country is anxious to give its own listeners the best possible conditions for the reception of its own programmes, and this must inevitably lead to difficulties in neighbouring countries which are all trying to do the same thing. It becomes a vicious circle.

The Ether.

There is only one medium, the ether, for the propagation of wireless waves, so that the only means of keeping one programme clear of another at the receiving end is to transmit on different wave-lengths. But assuming that each programme is heard at the same strength when the receiver is properly tuned to it, what must be the difference in wave-lengths to ensure that only one programme is heard? No

answer to this question can be given when one talks of wave-lengths. For instance, suppose a programme on a 300-metre wave is clear of a programme on a 320-metre wave, it does not follow at all that programmes on other waves which differ by 20 metres are clear of one another. In fact, it is most unfortunate that emissions were ever thought of in wave-lengths.

"Frequencies."

For several years now, therefore, everyone has tried to think of them in frequencies, not in wave-lengths; and no doubt there are some who have been fortunate enough to succeed. In any case it is essential to employ the term "frequencies" instead of wave-lengths in discussing interference, even if one does find it difficult to think about them. All wireless waves, no matter what their length may be, travel through space at the same speed, just as the various wave-lengths of visible light, which are recognized as various colours, travel at the same speed. The wireless waves are transmitted by the oscillations of electric charges in the aerial at the sending station—one complete wave for one complete oscillation—the wave-length being the distance between the front of one wave and the front of the following wave. Since the speed of travel is always the same, no matter what the wave-length may be, it follows that the quicker the oscillation the shorter the wave, so that each wave-length corresponds to a definite rate of oscillation per second, or as it is called, frequency. For example, the national programme (London region) is sent on a wave-length of 261.3 metres, which corresponds to 1,148 thousand oscillations or cycles per second, usually called 1,148 kilo-cycles per second (k.c/s.). The London regional programme is sent on 842 k.c/s., and these two programmes can very easily be received clear of one another. The difference between them is 306 k.c/s., and if they used any other frequencies which differed by that amount they could just as easily be received clear of one another. That, then, is a great advantage of thinking in frequencies instead of wave-lengths when considering interference. This

is not all wholly accurate in practice, but it is simple and accurate enough for our purposes.

As every listener knows by experience, these two frequencies are far more widely separated than they need be when using a good receiver; that is to say, their frequencies could be much closer than 306 k.c/s. without causing mutual interference. In fact, about 10 k.c/s. would suffice under suitable conditions with a good receiver at a reasonable distance from the stations. Why then are conditions not made suitable everywhere, and why is every station not arranged so as to transmit a frequency which differs by at least 10 k.c/s. from that of any other station? The answer is that owing to various considerations, many of them financial, it has been found impracticable to provide always the suitable conditions, and this has resulted in practice in there not being sufficient frequencies available to allow Europe to be mapped out on this simple plan, as many other important services besides broadcasting have to be considered.

A New Conference.

At the last international radiotelegraph conference held in Washington in 1927, the main band of frequencies assigned to broadcasting was that lying between 55 k.c/s. and 1,500 k.c/s. This band comprises 950 k.c/s., and in Europe at the present moment there are 183 stations crowded into it, nearly twice as many as a 10 k.c/s. separation would allow. It is true that some of these stations are of small power and cannot therefore cause much interference, but others are powerful and do cause interference over large areas. The general tendency, too, is to increase the number of powerful stations so as to provide economically the services which are considered necessary by various countries. Is there any wonder then that there is confusion in the ether? The International Union of Broadcasting, which consists of delegates from the broadcasting authorities of European countries, has tried hard to keep the confusion within reasonable limits, but from the reports of their last meeting in October, it seems likely that the whole question will be raised at the next international conference on radiotelegraphy, which is due to meet at Madrid in the autumn of next year. This will be a conference of the governments throughout the world which are interested in wireless communications, and will have under review all the regulations laid down by the previous conference at Washington in 1927.

Meanwhile, it is understood that the Union has recommended some minor changes in frequencies which would ease the situation if adopted by the

countries concerned. The separation between some of the frequencies of the stations which are now causing interference would be increased, which would of course help matters. The suggested changes would affect slightly the frequencies of our stations at Brookman's Park and Moorside Edge. The separation, too, between the Langenburg station and our northern regional, and between the Muhlack and London regional would be brought up to 10 k.c/s., an arrangement which would be welcomed by listeners in this country.

In addition to this main band of broadcasting frequencies, there is available a long wave band between 194 and 160 k.c/s., and in this band we have one station, Daventry, on 193 k.c/s. which transmits our national programme. Then again, there are half a dozen short wave bands available above 6,000 k.c/s., but these are only of use for very long range work such as broadcasting from this country to the Empire; and the B.B.C. has recently announced that it proposes to inaugurate an Empire service.

In October, too, it was announced that the Marchese Marconi had carried out successful experiments over a distance of ten miles with ultra-high frequencies, corresponding to waves of about only half a metre in length, and last spring, as described in *Discovery* for May, the International Telephone and Telegraph Company telephoned across the English Channel on a wave-length of only eighteen centimetres.

As it was then pointed out, however, these very high frequencies can only be used for communication between places which are "in sight" of each other, so that their application to broadcasting must be strictly limited; but every little helps, and with television coming along to absorb more frequencies, the little help may make all the difference.

An Appeal to Listeners.

Another method which, in a sense, helps to limit interference is the arrangement by which programmes are received at a central station, where expensive apparatus can be used, and are then relayed by means of wire circuits into the homes of the people. This method, however, cannot provide the wide choice of programmes which many listeners seem to desire. It is indeed the desire for a wide choice of programmes that makes the whole problem so exceedingly difficult, and if listeners were only satisfied, for a time at least, with a choice of two or three programmes, there would be little talk of confusion in the ether. What so many people unfortunately expect is a wide choice of programmes on an inexpensive receiver, an expectation which is really ahead of present technique.

Four Hundred Years of Mexican Art.

By Count René d'Harnoncourt.

Little is known in this country of the arts of Mexico, and special interest therefore attaches to this article by an authority. Although Mexican art has been subject to much foreign influence, it has preserved its individuality to a remarkable degree through four centuries of development from the crude "peasant ware."

THE fusion of two well defined and highly developed cultures is necessarily a matter of centuries. If circumstances force the bearers of different theories to create and to work in close contact, a mutual influence will soon be manifest in certain details of their products. But the complete fusion which is indispensable to the creation of a new, distinct and individual civilization can only be brought about by constant co-operation between the two peoples over a long period of time.

During the process of assimilation the form elements of the one tradition, which cannot be accepted or understood by the other people, will eventually disappear; others particularly suited to adoption by both partners in the evolution will take an outstanding place in the new culture, and the rest of the form elements will be adjusted and changed over and over again until they correspond with the basic conceptions of both cultures.

We find, however, that the new art born from the union of two well defined but dissimilar traditions often inherits designs and motives almost entirely from one of them, while it follows the other more closely in conceptions and formulation. If the fusion is the result of a military conquest or invasion it seems only logical that motives and designs will appear as the conqueror's contributions: his commanding position in the political and economic life of the country gives him the power to choose the subject of decoration. In many cases he also supplies models of his own art. But the conquered one, who executes these orders, will

unconsciously adopt the given forms as his own style and in this way contribute his own conception. This is especially true during the earlier periods of the process, before the absorption of the conqueror by the conquered country makes away with social distinctions and the two people fuse to form a new race.

Very little is known about the development of Mexican art during the first two centuries of the Spanish colony. Contemporary records, if they mention artistic production at all, deal exclusively with works imported from Europe or made in the new world by European craftsmen brought over by the clergy. The artistic value and perfection of their workmanship is undeniable, but they cannot be described as Mexican since they carry the spirit of their motherland in every detail. Glass-blowers from Italy and potters and weavers from Spain settled in the most important cities of the colony and established guilds of the European type. It is characteristic

of their attitude towards the native craftsman that the potters' guild in Puebla established a rule that nobody but a Spanish-born artisan could become a master potter and produce "fine ware." The importance of the fine artisan colonies in Mexico lies in the influence which their products exercised on the native craftsman. Their designs were adopted in a modified form all over the country and they contributed much in this indirect way to the formulation of the Mexican style.

One of the outstanding pottery centres in Mexico,



SEVENTEENTH CENTURY BOWL.

This wooden bowl, decorated in lacquer, is typical of 17th century work.

which expresses the true Mexican theory in all its products, is the town of Tonalá near Guadalajara, Jalisco. Its style is the example *par excellence* for the evolution of Mexican art in general. The earliest pieces known are big jars called "tinajas," decorated mostly with the Austrian double eagle. This emblem was brought to Mexico by the Spaniards in the sixteenth century when the Hapsburg dynasty occupied the Spanish throne. The contrast between European designs and native technique is unmistakable in these pieces. The "tinaja" from the late eighteenth and early nineteenth centuries is already much more uniform in its subject matter and style of execution. The European origin of its floral and animal decoration is hardly discernable, and the general impression of the jar is that it is a production of a distinctly new cultural tradition. In the modern products of Tonalá the fusion of tradition is complete. We find the European elements transformed and assimilated by the native craftsman into his own conceptions. In many cases we can even trace oriental form elements, brought directly to Mexico from the far west or imported from Spain. The potters of Tonalá have always enriched their own wealth of design by elements taken from foreign countries, but they have been strong enough to create from these a new art entirely their own.

The arts of Mexico have developed since the conquest not only a distinct national style but they have also become more varied and refined, while true Mexican art in early and colonial days, with the exception of the few examples mentioned, was restricted to "peasant ware." In the eighteenth century we see it conquer the small town and in the early nineteenth century absorb most of the foreign products all over the Republic. Only during the last fifty years has the cheap machine-made import proved to be



MODERN POTTERY.

It is interesting to compare this vase with the bowl on the previous page.

a dangerous competitor and a hindrance to native production. Among outstanding products of Mexico which represent the fusion of the Spanish tradition with that of the original native is the lacquerware from the states of Guerrero and Michoacán. This work seems to me to be among the most interesting of the Mexican products.

Despite the corrupting influence of foreign contact, modern lacquers from Michoacán still show the technical perfection of the older pieces. The elaborate process remains virtually what it was before the coming of the Spaniards. The lacquer is prepared from ochre, two kinds of powdered and burnt quartz, and a grease obtained from vegetables and pulverized insects. The mixture is coloured

dyes and applied by hand in many coats to the surface of the object, the solid coloured background of "fondo" alone representing many laborious hours. The design is then engraved on the ground layer and the decorations inlaid with vari-coloured lacquers. Finally the object is polished with the bare hand until a high finish is obtained.

The individuality of the Guerrero products is due as much to the technique employed as to ornamental tradition. The materials are for the most part the same as those used in Michoacán but the method of application is different. The object is covered with two contrasting colours in layers, the design being obtained by cutting away the top layer and allowing the fondo to show through. In other centres of production the decorations are painted on over a lacquer background, while in the state of Chiapas the objects are entirely painted. The skill, good taste and refined workmanship of the Indian artist may be seen to better advantage in no other of the popular arts of Mexico than in the lacquered and painted objects, an example of which is on page 390.

Some of the decorated objects like the birds and fish made from gourds are so much in keeping with modern interior decoration that it is hard to believe that they are not a recent innovation. There are a few examples of these from the early nineteenth century, and there is no reason to believe that they were not made much earlier. The purity of colour and simplicity of design make them seem a part of the modern designer's plan. Although this work is already much in demand by the tourist trade in Mexico it remains distinctly native in its style and conception.

Another craft which clearly shows the development of a fusion between conqueror and conquered is the textile weaving and decorating which can be traced from the colonial epoch. Although only small fragments of early textiles survive, it is certain that the art of weaving was well known in pre-conquest Mexico, for the codices or picture manuscripts show many of the uses to which textiles were put. The modern Indian's "zarape" or blanket is probably a lineal descendant of the ancient "tilmatli," the word itself being a Spanish corruption of the Aztec "tzalape"; but the manner in which it is worn is derived from the Spanish horseman's way of adjusting his cape. On the other hand, the Indian woman's most characteristic garment, the "rebozo," is probably an Indian adaptation of the original Spanish shawl. These have since become characteristic parts of Indian costume, but during the colonial epoch, although they were already being worn by the Indians, the finer pieces from the native hand looms, often representing the labour of months, were still destined for the upper classes. The colonial "zarapes" and "rebozos" are among the best examples of weaving produced in Mexico; even these, which were made at the express order of the ruling classes, show a native influence in colour and design. Embroidery and bead work are both of European derivation.

Of the former the articles made by the Indians for their own use or for church decoration are highly individual in colour and design and show little foreign influence. Beadwork, too, although it has remained a diversion or an exercise in industry for nuns and ladies of leisure, exhibits a technique found nowhere else in the world. This work is practically extinct in modern Mexico and does not assume much importance in modern applied art.

Hand-woven Indian textiles for domestic use still have an important place.

The articles which are still produced in greatest quantities are the "zarape," the "rebozo" and the "faja" (sash) which may be worn by either men or women according to style and design. Of these the "zarape" is the most conspicuous and best known. The products of such centres of manufacture as Teotitlan del Valle, State of Oaxaca, Toluca, State of Mexico, Santa Ana, State of Tlaxcala, San Miguel Allende, State of Guanajuato, Saltillo, State of Coahuila, and the State of Michoacan, are known all over the Republic. "Rebozos" and "fajas" have also their multiple styles and vary widely in different localities. The blue "rebozo" is the best



MURAL DECORATION.

Part of a contemporary decoration, characteristic of modern Mexican art.

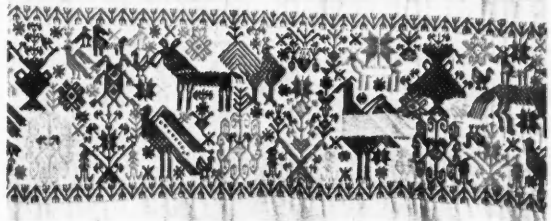
known. Primitive wooden hand looms of a kind which most fairly approximate their ancient prototypes still exist in many of the small villages. Objects are made either for personal use or in such well-established weaving centres as those already mentioned for local trade and export. Other modern weaving besides the "zarape" and "rebozo" is carried on in the cities of Oaxaca and Puebla, which have small factories making cotton cloth in highly coloured and distinctive design for aprons, napkins and towels. This cloth retains the quality of hand-woven goods and is highly decorative.

The development of Mexican painting exhibits the same fusion of the Spanish and Indian found in the applied arts. There is a great difference, however,

in the result. Modern Mexican crafts are still in danger of being corrupted or destroyed by the endless stream of foreign form elements which invade the country, while modern Mexican painting is so well-established that foreign painting is more likely to copy than to replace it. Mexican painting to-day is usually thought of as starting at the time of the revolution of 1910 and growing with the increasing consciousness and intense development of modern Mexico which reached its height during the time of Obregon in the early twenties of this century. In order to understand the greatness of the modern paintings we must look to their origin in the colonial and early republican pictures which have survived. The majority of Mexican primitives come from the states of Guerrero, Michoacan and Guanajuato, and date from the seventeenth and eighteenth centuries.

During the three centuries of Spanish rule the painters were entirely in the service of the church. There are celebrated names among the colonial painters, notably that of Miguel Cabrera, but none of them is genuinely representative of the spirit of the country. Excellent technicians, these early painters employed their talents in reproducing Spanish and Italian models which alone found favour in the eyes of their aristocratic or ecclesiastic clients.

The first manifestation of true Mexican art in the Indian villages appeared from the brushes of Indian



MODERN EMBROIDERY.

The odd designs peculiar to Mexican work are well illustrated in this piece.

painters hired by parishes too poor to acquire the work of more pretentious artists with European training. This fortuitous circumstance gave birth to the colonial primitive, still one of the finest flowerings of Mexico's artistic life. Engravings and book illuminations were the patterns given the native artists for guides, but an exact copy never resulted. Subject and general style of composition are all that recall the originals; spiritual content and technique are entirely Indian and often give the primitive a character antedating the models from which the artists worked.

In the nineteenth century the bourgeoisie of the young Republic began to recognize his political importance, and since he could not afford the work of the French artist who flourishes in the larger centres at that time, he had to be content with the work of the local portrait painter. The work of the Mexican painter had much in common with the European paintings of the time because he was commissioned to paint in the French manner. But in spite of this slavish obedience to foreign tradition the native workman could not completely kill his own national character, so being unhampered by academic schooling his work displayed a native quality which gave it a peculiar charm. During the twentieth century the Mexican artist has for the first time in history proudly proclaimed his work as a conscious and true expression



NINETEENTH CENTURY VASES.

Two Mexican vases of quaint design, produced about the year 1800.

of the culture of his country. He has been fortunate in having a government and people who live with his work as he does. He has discovered the medium which seems best to tell the world what the Mexican culture is, and has used this medium in a way which makes it an outstanding factor in the world of art.

The frescoes of modern Mexico are the key to the history, ideals and aspirations of the Mexican. The walls of the Ministry of Education provide a pictorial history for the people of Mexico as well as for visitors to the capital. The peasant who visits the city for the first time feels as much akin to these messages from the great artists of his country as the critics of the world.

These paintings achieve their harmony through

their direct relationship with the architectural proportion of the entire building.

The fresco paintings in Mexico have exerted a powerful influence over the easel paintings. Any exhibition of the works of the younger artists in Mexico displays in subject matter and colour, almost in treatment, the life depicted in the frescoes. There is a group of young artists who have studied in Europe and who have been influenced especially by the modern French school. A unique and interesting result can often be seen in their work despite the form of the modern French school employed in their paintings. Their work is instantly recognized because the subject matter, the treatment of form and textures and the brilliance of colour, is unquestionably Mexican.

Correspondence.

"BIOLOGY AND MANKIND."

SIR,

I should like to assure the reviewer of my book "Biology and Mankind" that I yield to none in admiration of the noble and tragic figure of Lamarck. The vast majority of zoologists would, I believe, agree with me that not only did Lamarck fail to produce any direct evidence of use-inheritance, but that an immense amount of subsequent work specifically directed to the point has also failed to produce such evidence as is finally convincing. I am well aware that there is a school, led in England by an honoured zoologist, which thinks otherwise. To this school your reviewer clearly belongs. My personal view is that there is antecedent probability that the Lamarckian factor is operative, to some extent at least; but honesty compelled me to point out that all attempts to prove that it is have so far failed to yield evidence convincing to most zoologists, while the contrary evidence is strong.

Yours faithfully,

STEWART A. McDOWALL.

Winchester.

POSTSCRIPT.—Since writing the above letter I have read Dr. R. A. Fisher's paper on the "Evolution of Dominance." A first reading makes me think that some at least of my reasons for inclining to accept a certain antecedent probability of a Lamarckian factor in evolution are for me no longer valid. Dr. Fisher adduces evidence which offers a satisfactory solution of some of my difficulties, a solution in line with the impressive array of Mendelian evidences; and I am driven by it towards the view that there was less antecedent probability of a Lamarckian factor than I had thought.

PROFESSOR E. W. MACBRIDE, who reviewed "Biology and Mankind," writes: I am sorry that Mr. McDowall thinks I have misrepresented him. I accused Mr. McDowall of three things: (1) that he asserted as generally accepted the views of one narrow school; (2) that he gave an incorrect view of zoological history; (3) that he was unfamiliar with the real outlook in zoological science to-day. Mr. McDowall's postscript affords convincing evidence of the truth of my contention. After reading Dr. R. A. Fisher's paper on the "Evolution

of Dominance" he is prepared to surrender a prejudice in favour of use-inheritance which he formerly had. Dr. Fisher, though an eminent mathematician, is without any biological training. If Mr. McDowall means that Lamarck produced no *experimental evidence* in favour of use-inheritance, this is true; but it is equally true that Darwin produced no experimental evidence in favour of his competing theory. The difference between them is this, that whereas in recent years a considerable amount of evidence in favour of Lamarck's hypothesis has been brought forward, definite proof by specially arranged critical experiments has been obtained that Darwin's assumption is false. All theories of evolution must, of course, accept "natural selection," which under another name was as well known to Lamarck as it was to Darwin. But the reason that natural selection is universally accepted is the same as that given by my friend Dr. Schiller, the distinguished philosopher, for the general validity of the Kantian categorical imperative, viz., that it means nothing in particular. Natural selection only means "that the survivors survive." But it must always be remembered that Darwin did accept "use-inheritance" as a partial explanation of evolution and that Haeckel, the famous protagonist for evolution in Germany, accepted it wholeheartedly and dedicated his book "The History of Creation" to Jean Lamarck and Charles Darwin.

Mr. McDowall seems to be unaware that the whole Weismannian theory has been pulverized by the researches in experimental zoology undertaken in the last thirty years. The "vast majority of zoologists" are hard-worked teachers prosecuting research in some special department of the animal kingdom, but not possessing the knowledge which would qualify them to judge either of the antecedent probability or of the experimental evidence in favour of use-inheritance. But from evidence accumulating on my desk from all parts of the world it is clear that those who have this special knowledge are being driven one by one into a position which although they do not call it Lamarckism is indistinguishable from that held by Lamarck. As to experimental evidence, it is only of recent years that any systematic attempts have been made to test use-inheritance, and in my judgment convincing evidence of its birth has been obtained.

An Historic Stone from Nazareth?

By the Rt. Rev. Mgr. A. S. Barnes, M.A.

An interesting discussion has arisen regarding an engraved stone from Nazareth which has been acquired by a Paris museum. The author here examines a theory that this is the stone on which was recorded the reply from Tiberius to a question from Pilate about the discovery of the "Empty Tomb."

A YEAR or two ago, when the collection of the late M. Froehner was placed in the Cabinet des Médailles at Paris, attention was drawn by M. Franz Cumont to an engraved stele bearing a Greek inscription, which had remained hitherto unnoticed, although it had been in Paris for half a century. It was an idiosyncrasy of M. Froehner to keep his possessions secret. He would have nothing about them published, nor would he even allow them to be examined.

The Text.

There is no dispute as to the text. M. Cumont has copied it very carefully and accurately, and the stone is uninjured so that the text is complete. It runs as follows:—

Διάταγμα Καίσαρος.

Ἀρέσκει μοι τάφους τύνβους
τε, οἷτινες εἰς θρησκείαν προγόνων
ἐποίησαν ἢ τέκνων ἢ οἰκείων,
τούτους μένειν ἀμετακινήτους
τὸν αἰῶνα· ἐὰν δέ τις ἐπιδ(ε)ίξῃ τι-
να ἢ καταλελυκότα ἢ ἄλλω τινὶ
τρόπῳ τοὺς κεκηδευμένους
ἐξεργιφύοτα ἢ εἰς ἑτέρους
τόπους δώλῃ πονηρῶ με-
τατεθεικότα ἐπ' ἀδικίᾳ τῇ τῶν
κεκηδευμένων ἢ κατόχους ἢ λί-
θους μετατεθεικότα, κατὰ τοῦ
τοιούτου κριτήριον ἐγὼ κελεύω
γενέσθαι καθάπερ περὶ θεῶν
εἰς τὰς τῶν ἀνθρώπων θρησ-
κείας πολλὴν γὰρ μᾶλλον δεήσει
τοὺς κεκηδευμένους τιμᾶν·
καθόλου μηδενὶ ἐξέστω μετα-
κινήσῃαι· εἰ δὲ μή, τοῦτον ἐγὼ κε-
φαλῆς κατάκριτον ὀνόματι
τυμβωρυχίας θελω γενέσθαι.

In the inventory of the collection this piece is noted simply as "Sent from Nazareth, 1878." Other pieces are marked more definitely as "Found" at such and such a place, but this one has no record of its place of origin. It is not a large stone, or rather

marble; about two feet in height by one foot six inches in breadth. The lettering, as every one agrees, seems to date it as belonging to the first years of our era. As it has no history we can now only interpret it by its contents.

No doubt the original was in Latin. It was the custom for the Emperor to write to his representatives in the provinces in Latin, and it was for them, if translation were needed, to arrange for it to be made by some official attached to their headquarters. In this case the translation seems to have been done by some one, probably a Syrian or Hellenized Jew, who was not too sure either of his Greek or his Latin. It is not well translated, and though this enables us sometimes to reconstruct the Latin, by the very fact that the Greek is simply a literal translation of Latin technical terms, it leaves us in other cases a little doubtful as to the exact meaning. On the whole I would venture to translate it as follows:—

A MANDATE OF CÆSAR.

"It is my pleasure (*placet mihi*) that those sepulchres and tombs which have been erected under the sanction of 'religion' for parents, children or relations, shall remain unmolested for all time. If then anyone shall prove that another has destroyed such tombs; or has in any way whatever exhumed the bodies of those who have been buried; or has unlawfully removed them to another place to the injury of the dead; or has removed the inscription or the stones (of the tomb); I command that judgment be pronounced upon him according to the laws which govern these religious sanctions of the gods in human matters.

"Beyond all else reverence must be shown to the buried. No one is allowed to remove their bodies. If anyone does so it is my will that he should be condemned to capital punishment on the charge of forcible violation of a sepulchre."

Roman Law.

I venture to suggest that modern commentators on Roman Law have not always rightly understood the law *de sepulchro violato*. The jurisdiction in such a matter was a double one. The primary and by far the most important was the "religious"

jurisdiction, and this was in the hands of the *Collegium Pontificum*. No Roman cared much for the reverence due to the human body as such. A corpse might be thrown into the pits of the Esquiline, or even exposed to be devoured by birds and wild animals. That, in itself, shocked but few. But if a corpse had once been solemnly buried, that was a very different matter. The body itself and the whole monument which enclosed it had not indeed become the property of the *Dii Manes*, the gods of the Lower World*, for property can only be held by men, but had been placed under their protection. To interfere henceforth with either tomb or body was, therefore, an act of impiety to the gods, and as such called for the severest punishment, even that of death.

Ancient Beliefs.

This whole circle of ideas, and the legal sanctions which enforced them, go back to the very earliest ages†, and were quite possibly not found written in any code, being more ancient than any. But the destruction of a tomb or the wrongful removal of a body had another aspect besides the "religious" one. Although actual proprietorship over the tomb had lapsed when it became a *locus religiosus* by receiving the body, yet there was a certain civil injury involved in its wrongful destruction. This civil injury, or tort, was dealt with by the Praetor and there is a well-known Praetorian Edict which governed the procedure. But the Praetor had nothing to do with the "religious" side, nor had the Pontifices with any civil tort. It has been the habit of most commentators on Roman Law, owing no doubt to the fact that no ancient treatise *De Religionibus* has survived, to treat the action of the Pontifices as a minor development and the Praetorian Edict as the original enactment. The truth is, I imagine, exactly the reverse.

We have here, as it seems to me, the Emperor acting as Pontifex Maximus and enforcing the ancient Roman Law in a Province. There is no reason for saying that the order was issued in answer to a question submitted to him, so that it would be a "rescript." The Greek for rescript is not the same as the word "mandate" used in the title. This Order has much more the character of a *motu proprio*, sent by the Emperor of his own accord; the result of some atrocious act of violence which had been reported to him; an act of violence directed apparently not so much against a tomb as against the human bodies

contained in the tombs. This crime has stirred the Emperor's indignation, and led him to make this Order so as to ensure that nothing of the kind shall occur again, and, further, to bring about the condign punishment of those guilty of the criminal and sacrilegious act. Who then was the Emperor and what was the sacrilegious act, involving the actual bodies of the dead, which was the occasion of the mandate?

M. Cumont, while inclined to put the date of the inscription, judged by the form of its lettering, some time in the later years of Augustus, is of opinion that we cannot exclude a later date, so that Tiberius is not impossible. "If so," he goes on to say, "one is naturally tempted to connect this prohibition with the greatest event that happened in Palestine under that Emperor's reign. According to the Gospel, when the tomb of Jesus was found to be empty, the priests of the Temple caused the soldiers to say that certain disciples had stolen the Body during the night. This accusation soon gained credit, at any rate among the Jews themselves.

"So again the Apologists of the second century refer constantly to a report on the death of Jesus which had been sent by Pilate to Tiberius, and, although the personality of Pilate has raised up an apocryphal literature of very doubtful value, it still seems likely enough that the Procurator of Judaea, as a good Roman functionary, did actually inform the Emperor of the dissensions which were then troubling his administration and of the matters which had caused their rise.

"Further it is quite possible that Pilate, noting the accusation which the Jews had brought against the disciples, did actually ask for instructions from the Emperor. In that case our "Mandate of Caesar" would be an extract from the Emperor's answer. This extract would have been engraved on marble and erected at Nazareth, the actual place from which Jesus had come, and which still remained hostile to Him. This would explain the discovery of this document in a small town in Galilee, where otherwise there would be no particular reason for publishing a law of Augustus."

A Startling Hypothesis.

Such is the somewhat startling hypothesis which M. Cumont puts before us, and which he seems actually to prefer to the more prosaic idea that it is in origin the work of Augustus, long before our Lord began His ministry. Père Abel of the École Biblique at Jerusalem, discusses the question in the *Révue Biblique* (1830, p. 567), and finds the hypothesis of

*The Manes were the friendly spirits of those who had been duly buried.

†Cf. the law of Julian the Apostate, based avowedly on earlier practice "*maiores semper habuerint.*" *Codex Theod.* ix, 17, 5.

M. Cumont distinctly attractive; *séduisante* is the word he uses. Père Legrange also adds a note, and he too seems to give his blessing to the theory, and Professor Sayer in conversation seemed to me to lean in the same direction.

M. Cumont has not failed to find, therefore, support for his suggested hypothesis, slight and uncertain though the foundations upon which it is built up must certainly be judged to be. If he could prove his case the stone would be one of the most interesting and important monuments in the world. What could be of more outstanding interest and importance than the actual stone on which is recorded the answer sent by the Emperor Tiberius to a question addressed to him by Pontius Pilate concerning the events attending the Resurrection of Jesus Christ, and especially the discovery of the Empty Tomb?

The names I have quoted are, no doubt, great ones, the names of authorities from whom one would be slow to differ. Yet to me, as I have studied the subject, this solution, attractive as it undoubtedly is, so that one would wish to accept it, has seemed ever increasingly improbable and even altogether impossible.* The reasons will, I think, become clear as we go on to consider the question in detail.

Julius Caesar is out of the question, for Judaea did not become a Roman Province under the Emperor till after his death. It was under Herod the Great, and after Herod's death passed to his son Archelaus. It was not until Archelaus was deprived of his kingdom in A.D. 5 that Judaea was placed under a Procurator by Augustus. Our Mandate must, therefore, be later than A.D. 6.

Title of "Caesar."

On the other hand, the use of the single word Caesar without any other name suggests Augustus himself very strongly. It is true that in the New Testament we have several instances of the simple title of Caesar designating later emperors. St. Paul, for instance, appeals simply to "Caesar," and the reigning Emperor was Nero. But we must distinguish to some extent between Caesar used as designating an office, and as a personal name. In the latter sense it is used generally only for Augustus; naturally enough, for he was the first and till then the only Caesar they had known. Josephus, for instance, recounting the death of Augustus, speaks of him, as always, simply as Caesar. But in going on to tell of his successor he always

names Tiberius. We may say that, while it is not conclusive, the strong probability would be that the simple title would have designated Augustus rather than Tiberius. In that case we must date the stone as between A.D. 6 and A.D. 15, the year of the death of Augustus.

The Lettering.

Père Abel has drawn attention to the close similarity in the form of the characters of the inscription to those of another monument—the marble erected, probably in A.D. 15, to commemorate the opening of the Synagogue of Theodotus, at Jerusalem. Père Tonneau O.P., of Freiburg, has made the closest possible comparison of the two, with the result that he finds the form of every letter is identical, with one solitary exception—the E—which has the perpendicular stroke on the middle member in our stone but not in the Jerusalem one. This seems almost to prove that both are the work of the same stone cutter. But the Jerusalem one is the better, which would seem to show that he had by then become more skilful, so that we are inclined to date the Nazareth stone a few years before A.D. 15. This, again, bears out our attribution of it to Augustus rather than to Tiberius.

It must be noted that the stone is entered in the catalogue only as "sent from Nazareth." That cannot have been the place where it was originally erected, for Nazareth was in Galilee and under the Tetrarchy of Herod Antipas. The Mandate of a Roman Emperor would not have been set up there. Clearly it must have been "found" elsewhere, in some place within the Roman Province of Judaea. It must, then, have been taken to Nazareth, probably as a likely market, and thence despatched to Paris via Haifa.

Sepphoris has been suggested by Père Tonneau as a likely place, being a Greek city only six miles from Nazareth. But it is impossible for the same reason. It was in Galilee. What we have to look for is some place S. of Nazareth, on the road to Jerusalem, but not too far S., as in that case Jerusalem would be the easiest market. Sebaste exactly answers the required conditions—the capital of Samaria, recently built by Herod and called after Augustus himself, only a day's ride away across the level plain of Esdraelon, while Jerusalem on the same main road, or rather horse track, for in 1878 there were no roads available for wheeled traffic anywhere in Palestine, is a much longer and more difficult journey through the hill country of Judaea. Sebaste, or its near neighbour Shechem, seems to be pointed out, almost with mathematical certainty, as the place where our stone was

*This article was written before I had seen the work of Mr. Jérôme Carcopino in the *Revue Historique*, Jan., 1931, who anticipates me in several points.

originally set up and where it must have been found before it was brought to Nazareth.

Lastly, the whole tone of the document fits far better with the character of Augustus, the earnest protector and restorer of the ancient Roman religious system, than it does with Tiberius. There is a personal note in it. The Emperor is genuinely shocked and speaks from the heart. The general tone almost, as M. Cumont says, amounts to a signature of Augustus himself.

An Act of Sacrilege?

Putting all these probabilities together on the principle that, although each by itself may be no more than a probability, yet the concurrence of all amounts almost to a certainty, we come to the conclusion from the study of the text that what we have to look for as the original cause of the Mandate being sent and erected at Sebaste, is some notable sacrilegious action, involving not only the violation of sepulchres but also insult and desecration of the actual bodies they contained. We shall expect to find that this sacrilegious act, whatever it may have been, took place in Samaria, or at least that Samaritans were involved. Otherwise why should the order be at Sebaste, while there is no trace of it elsewhere? We shall expect to find that the date of this action will be between A.D. 6, when Coponius was first sent as Procurator, and A.D. 10 or 12, which is about the date suggested by the characters of the inscription. The act, whatever it was, must have been sufficiently notable for the report of it to have reached Rome, and sufficiently horrible to rouse the Emperor's indignation and anger.

Now it is remarkable that there is just such an incident, occurring precisely at this date, which is recorded by Josephus. There is a *lacuna* in the text, but it is not of very great consequence. The passage is in the *Antiquities* xviii, 2, 2, and the incident is thus recounted by Ewald (*Hist. of Israel*, vi, 63, Engl. trans.). "During the time that Coponius held his office the only thing recorded is a disgraceful deed of the Samaritans. . . . Some of them . . . stole at Easter to Jerusalem and in the night of the Passover (A.D. 8 probably) after the doors of the Temple had been opened according to ancient custom, threw about human bones, both in the porch and in the sanctuary. Thereby the House of God was, according to ancient ideas (*Numbers*, xix, 16) so completely desecrated that this time no ceremonies could be held in it at the feast, since it had first to be solemnly purified again by special sacrifices offered during a period of seven days. Precautions were taken against the repetition of similar scandals, but it may easily be

conceived that thereby the ill feeling and commotion in Jerusalem which had been scarcely alleged, increased. Probably on account of this new danger of internal revolt, Coponius was recalled to Rome after only a brief period of office."

It seems to me that we need look no further for the event which called forth the Mandate before us. It seems to fit in every particular. The Samaritans had insulted the living as well as the dead; in Roman eyes they had offended the *Dii Manes* of the Lower World as well as the One Eternal of the Hebrews. They had wounded the Jews in their deepest feelings and strongest sentiments, and at the same time had shocked the heathen piety of Rome in one of the most ancient and fundamental points of Roman religion. Chastisement was clearly called for, and there would be no room for mercy. The Mandate before us suggests the penalty that was executed by Rome. So far as the Jews were concerned never again, as long as the Temple stood, was any Samaritan allowed to enter its precincts. From that time forward "the Jews had no dealings with the Samaritans."

It is not only because this act of the Samaritans seems to offer so much more probable a reason for the issue of the Mandate that we must reject the "seductive" theory of M. Cumont connecting it with the events of the Resurrection. There is no solid reason to make us think that the Jews ever entered any real legal process against the disciples of Christ as "violators of the grave." All that St. Matthew's gospel seems to imply is the existence of current gossip, encouraged by authority. No legal action could possibly have lain, for the simple reason that the burial had never been completed. The women were coming on Sunday morning, as soon as the Sabbath was past, to complete the anointing. But under Roman ideas it was not till the burial rites were finished, and the body finally committed to the earth, that the place became *religiosus* or the body passed under legal protection. Even an actual and completed burial, if it were notified at the time as being merely temporary, conveyed no sanction. Under such circumstances the body might be moved freely without the leave of the Pontifices, though this was often sought *ex majori cautela*.

The Unburied Body.

Against the disciples of Christ, who, if the Jewish accusation had been true, would have merely removed a body, still unburied, from its temporary resting place, no charge of sacrilege could possibly lie. Certainly no report to Rome could have been necessary, nor would such an act call forth so emphatic a Mandate.

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Modern Research on Glass.

By T. C. Crawhall, M.Sc.

Department of Glass Technology, Science Museum.

Although glass has been the subject of research in this country for nearly two centuries it is only in recent years that real headway has been made. The latest developments are shown in an exhibition at the Science Museum.

STRANGE as it may seem, the exact nature of glass is not yet known. The extensive research of recent years has principally been devoted to the discovery of new glasses for specific purposes—largely due to the introduction of machine processes—and to determining the chemical and physical properties of the known glasses in order to extend their uses.

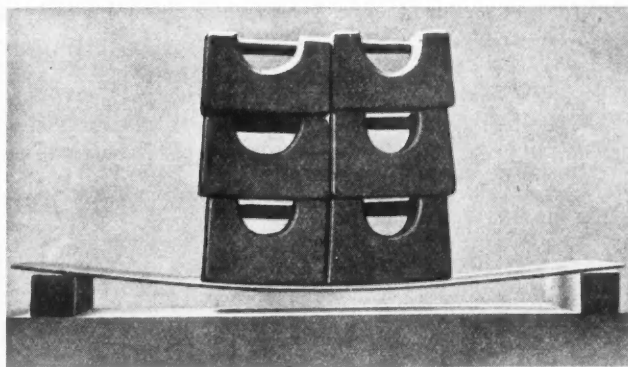
A little research of a more theoretical character has been done with the object of discovering what glass really is, and this has already caused many workers to discard, or at least to modify, the theory that glass is an under-cooled liquid. For it has recently been shown that when glasses are heated or cooled, absorption or evolution of heat takes place at a certain point, corresponding partly to a change of state. At this point sharp changes take place in the physical properties of the glass. Even in the lower temperature range, from 100 to 500 deg. C., internal changes have been observed during the last three years.

The study of the nature of glasses by X-ray examination has been carried out for some time in this country, and the results of this research have contributed considerably to our knowledge of what glass really is. Investigations suggest that those substances whose atoms are held together by strongly directional or strongly localized forces are those most likely to exhibit themselves in the form of glass. This is illustrated in the case of selenium. The atoms of rhombohedral selenium are arranged in parallel spirals and the distance between two neighbouring atoms in a spiral is considerably less than the shortest

distance between atoms of neighbouring spirals. The greatest part of the crystal energy is associated with the binding forces in the spirals. When liquid selenium is quickly solidified energy considerations are mainly satisfied by the growth of fragmentary spirals. The alignment of the spirals into true crystal formation is secondary. In this way the formation of selenium glass is pictured.

These and similar problems are illustrated in "The Nature of Glass" section in a special exhibition at the Science Museum. It has been arranged by the Society of Glass Technology in conjunction with the Glass Research Delegacy of Sheffield, and the object is to show the most striking developments of recent research in glass technology. The exhibition illustrates the relationship between the chemical composition and the physical properties of glasses with indications of the industrial results of the researches involved. While it is essential that certain parts of the exhibition are of a technical nature, the modern practical uses of glass are so widespread that they cannot fail to be of interest.

Lack of space has prevented the exhibition from being exhaustive, and such important researches as those connected with the solution of gases in molten glasses and the diffusion and flow of viscous liquids at high temperatures have been crowded out. Raw materials and refractories, upon which so much research has been carried out in recent years and which are so important to the glass industry, have had to be excluded with the exception of one small exhibit showing the iron content in the sand used in glass making operations.



ARMOURPLATE GLASS.

This is one of the latest types of glass evolved. It is supporting a load of six 56 lb. weights.

It is well known that sand, which is almost pure silica, forms the main constituent of glass, but it may not be so well known that sands contain iron to a surprisingly varied degree. It is this iron which causes the green colour in common glass, and for a clear glass such as is used for crystal ware or for optical instruments the iron

content must be as low as possible. This is obtained in the first place by using a sand as free from iron as possible, secondly by separating as much as possible of the free iron by passing the sand over magnetic separators, and finally by the use of chemical decolourizers. A piece of the purest optical glass which has yet been made and which is the outcome of persistent research is to be seen at the exhibition. For optical purposes and for crystal glass the sand is mostly obtained from Fontainebleau in France, while other good quality sand comes from Belgium. The sand obtained in England, from King's Lynn and elsewhere, can only be used for the common type of bottle glass where freedom from colour is not of such great importance.

A word on the materials which are used in the manufacture of glass may be of interest. For every 200 parts by weight of sand used in window glass there are 66 parts of limestone, 59 parts of soda ash and 10 of saltcake. The constitution of crystal glass is entirely different. For every 200 parts of sand there are 133 parts of red lead, 67 of potash and 11 of nitre with a very small amount of nickel oxide (about 0.0003). This type of glass is always considered to be a British invention, having been introduced in the last half of the seventeenth century. As is well known, its brilliance is shown up by "cutting," in which form it is mainly seen. The materials used in the manufacture of colourless bottles differ only slightly from those used for window glass. For 200 parts of sand there are 77 parts of soda ash and 48 of limestone, together with very small quantities of arsenic, cobalt oxide and selenium.

Glass research has been carried on in various forms for nearly two centuries. The historic work of Abbé and Schott at Jena and of Michael Faraday and others



GLASS SILK.

The photograph shows high pressure steam drums being covered with glass silk at a power station.

in this country are well known, but it was not until during the war that any form of systematic research was adopted. The need for glass for special purposes was then so urgent that it rendered necessary the formation of the Department of Glass Technology at Sheffield University and the Society of Glass Technology.

The most important researches in the world are done at the University of Sheffield and at the research laboratories of some of the large glass manufacturers in this country. Several years after the Society was founded the German glass manufacturers and technologists formed a similar society based on the British organization, recognizing that this was an essential and useful body.

Mention has already been made of the use of X-rays for discovering the nature of glass. In the exhibition this is shown by a small model of the apparatus used. Some of the other uses of this essentially modern method of analysis have led to an explanation of the fact that the density of a glass is usually less than the density of the same substance when in the form of crystals. The study of the devitrification of a soft soda glass, the detection of free cadmium sulphide in fluorescent uranium glasses and the detection of free copper in a ruby glass are among other uses to which X-rays have been put.

Commercial glasses while still molten are to be regarded as solutions from which one or more constituents may crystallize. Such crystallization is normally retarded because glasses are thick viscous liquids and also because glass manufacturing operations result in rapid cooling of the glass. Some operations, such as during the slow cooling of optical glass, provide conditions favourable for the separation and growth of crystals. Examples of this crystallization, or devitrification as it is known, upon which a large amount of research has been carried out, are shown in the exhibition. One particularly interesting specimen is a glass bottle which has been heated in an oven for several months. Devitrification has resulted so completely as to convert the bottle into a stone-like material not in the least resembling glass.

Glass is an extremely durable substance, and some specimens of Egyptian glass of the Eighteenth Dynasty (about 1500 B.C.) are instances of its marvellous preservation. They are almost in as good condition to-day as when they were made. The fact that certain glass made comparatively recently is not so durable has led scientists to consider this problem, and it has now been ascertained that the durability depends entirely upon the correct proportioning of the constituents. A slight error in one of these will cause the glass to change colour or to decay.

Manganese has been used for several centuries as a decolourizer and the misuse of this material frequently led to the development of a purple colour in the glass after exposure to the atmosphere for some time, a defect which may be seen even to-day in some old windows. The relation between the chemical composition and the durability of glasses is illustrated in the exhibition, and this line of research has led to the discovery of many new types of glasses which possess very high resistance not only to weathering but also to powerful chemical reagents.

This is particularly well illustrated in the section devoted to chemical glassware. On the outbreak of the war no chemical glassware was manufactured in this country. At the present day, so far as blown glassware such as flasks and beakers are concerned, no country has a wider variety of chemical glasses of the highest resistance type. The technique of manipulating these rather difficult glasses has also been satisfactorily acquired by the British manufacturers.

Allied with chemical durability are the physical properties of glasses, and here considerable research has been conducted during the past fifteen years. The properties which have been investigated include density, thermal expansion, heat conductivity and insulation, tensile, bending and impact strength, bursting pressures and viscosity, refractive index and dispersion, light transmission and absorption, thermal endurance and electrical properties.

Thermal Expansion.

To illustrate thermal expansion, an apparatus has been transported to the Museum from the research laboratory at a British factory, and by slight adaptation has been made to demonstrate automatically and continuously the expansion of a piece of glass due to its increase in temperature. A very short time ago it was possible to join two pieces of glass together only if they had somewhere near the same coefficient of expansion. In the early days of the electric lamp bulb the ends of the filament were connected to pieces of platinum wire because platinum was the only metal

which could be fused to the glass on account of its coefficient of expansion being practically the same as that of glass. This is all now a thing of the past, and it is possible to join almost any two glasses together or to join glass to copper and other metals.

Glass Silk.

One of the most interesting results of the research work done on heat conductivity is the use of glass silk in increasing quantities as an insulating material for covering high temperature boilers and steam pipes. Glass itself has a low thermal conductivity and when in the form of fine threads the large volume of air occluded between the fibres adds to its value as a heat insulator, while the polished surface of the fibres still further reduces the heat loss. Their length and flexibility successfully resist vibration and the glass will safely withstand temperatures up to 900 deg. F. for any length of time without disintegration. It is also chemically inert and can be cut with a knife.

A further use of glass silk is for the separator plates of electric storage batteries. Here the fact that glass is a poor conductor of electricity, or, in other words, a good insulator, is made use of.

The strength of glass may be considerably increased by toughening the surface by rapid cooling, but although this has been known for several centuries it is only within the last few months that it has been made a commercial proposition and little more than a month ago that it received the name of "armour-plate."

A piece of this glass $\frac{1}{4}$ -inch thick, three feet long and one foot wide will carry a weight of more than 24 stones when supported at its ends and loaded in the centre. The sag in the middle will be about two inches, and when the load is taken off, the glass will return to its normal shape. Nothing like it has been produced before, and quite obviously it must have immense possibilities. For one thing, it might quite easily prove a serious rival to laminated glass, which is so firmly established for use in motor-cars.

Laminated glass was invented as long ago as 1905, but was not made on a commercial scale until the war. It is known that laminated glass consists of two sheets of plate-glass between which is sandwiched a sheet of celluloid, or similar substance, fixed together by a suitable adhesive. Unfortunately nitro-cellulose, or celluloid, is not stable to light, and cellulose acetate, though popularly supposed not to discolour, does discolour slightly when laminated. Recently, considerable improvements have taken place in this respect, though the ideal non-discolourable laminated glass has not yet been discovered.

Book Reviews.

Seventy Years in Archaeology. By FLINDERS PETRIE.
(Sampson Low. 18s.).

Sir Flinders Petrie, born in 1853, commenced archaeology as a collector of coins at the age of eight. Now in his seventy-ninth year he is conducting excavations in Palestine. Thus the title of this volume, a chronicle of his work in archaeology as excavator, teacher and lecturer, makes no idle claim. For over fifty years, ever since 1880, he has spent each winter and spring in the field engaged in excavation. The only intermissions, if we except the war, have been when in the early 'nineties he was first appointed Edwards Professor of Egyptology at University College, London, and on occasion since the war when the state of his health has enjoined a less strenuous form of activity for a brief period.

For the greater part of his career Professor Petrie's activities centred in Egypt, though his work as a practical archaeologist began in England. In Egypt a long list of successful "digs" stands to his credit, and the exhibits in numerous museums in this country and in America are witness to his insight as a prospector. In this volume he chronicles his main results year by year. When the new regime in Egypt imposed conditions on the excavator which became too exacting, Professor Petrie in 1926 transferred the operations of the British School of Archaeology in Egypt over the border to Palestine. This change of field, the subject of much regret at the time, has proved something of a blessing in disguise, for the School has now unearthed the great city of the Hyksos Ajul, which will absorb its energies and all the funds likely to be at its disposal for some years to come.

Archaeologists will treasure these records, if only to recall the thrill which Petrie's results evoked year after year, whatever may have been the outlook when he started work at the beginning of a season. For reasons which he gives, this was by no means invariably favourable. The attitude of the responsible officials of the Antiquities Department, so far from being helpful, was often quite definitely obstructive. This, however, was only one, albeit the most serious, of the troubles of an excavator in Egypt.

Although no one could tell the story of these fifty years of exploration in Egyptian archaeology with the intimacy and detail with which it has been told by the author, it is impossible to forego a regret that the book should not have been written by another hand. Sir Flinders Petrie is too modest, too preoccupied with the work in hand from day to day, to pause to place his work and its results in proper perspective. Others would have shown that here is the life-work of a great pioneer in archaeological method, and of one to whom we are largely indebted not only for some of the most striking examples of Egyptian artistic skill in our museums, but also for much of the precise detail which has enriched, vivified and reconstructed our knowledge of Egyptian history and culture in prehistoric and early historic times.

Science in Action. By EDWARD R. WEIDLEIN and WILLIAM A. HAMAR. (McGraw-Hill. 15s.).

The authors are attached to the Mellon Institute of Industrial Research at Pittsburgh. Their object is to show the value of scientific research in American industries. Very wisely, they

are not content with general phrases but are at pains to cite a number of examples of useful and profitable research in various fields of human endeavour. American business men have long been willing to spend money on scientific research, and the authors believe that they have been amply rewarded. Old processes have been improved and cheapened; new processes have been invented; materials that once seemed useless have been turned to good account. Thus, the Du Pont de Nemours Company spends £700,000 a year in research. "In one three-year period a few years ago the direct and indirect savings from the research of this company amounted to twelve times the cost thereof." An American sugar company wanted to recover sugar from an inferior molasses, selling at 50 cents a hundredweight. Its chemists found out how to reclaim 35 pounds of sugar, valued at \$1.75, apart from various industrial salts and 9 or 10 pounds of raffinose valued at \$160 a pound. (We quote the authors' figures without comment.) The production of artificial sausage skins—"casings" they are called by polite manufacturers—from cellulose is described in some detail, as it is the outcome of long and costly research at the Mellon Institute. There, too, investigators are studying the poses of the human body during sleep, with the object of producing the ideal mattress. Baking, cold storage, the manufacturing of margarine and artificial silk, among many other instances, testify to the primary importance of the scientific man in industry. The authors deal rather lightly with the immediate effects of mechanization in human labour, and are more optimistic than most leading American economists appear to be at the present time. But their main case is clearly proved, and it would be well for Great Britain if our manufacturers and business men showed as much willingness to finance and profit by technical research as their American competitors have done for years past. The book is fully and attractively illustrated.

My Friend the Admiral. The Life, Letters and Journals of Rear-Admiral James Burney, F.R.S. By G. E. MANWARING. (Routledge. 12s. 6d.).

Readers of Charles Lamb's essays and letters are well acquainted with his friend, the Captain, who loved a game of whist after labouring all day on his history of voyages to the South Seas. This cheerful and literary sailor, who late in life was promoted Rear-Admiral, has at last found a biographer to do him justice. Mr. Manwaring has had access to the papers of the Burney family and has made full use of Burney's hitherto unpublished journals—in the Record Office and the British Museum—of his voyages with Captain Cook in 1772-74 and 1776-80. From the scientific standpoint these journals are the most important part of the volume, for any new light on Cook's achievements in the South Seas, the Antarctic and the Arctic is welcome and Burney was a careful and precise recorder. It is well known that Cook in 1774 brought home with him a native of the Society Islands, named Omai, who was fêted by London society, received by the King and painted by Reynolds. Burney acted as Omai's interpreter for a time, and Fanny Burney wrote some amusing notes on the young islander who, she thought, was one of nature's gentlemen. When Cook returned to the South Seas he took Omai back with him and had some trouble in disposing of the young man. Burney's account of Cook's third and last voyage is notable for his description of the Tasmanians whom he saw, for these very primitive people are long since extinct. Still more interesting is his diary for the eleven days of February, 1779,

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during which the "Resolution" and "Discovery" were anchored in Karakakooa Bay, Hawaii, where Captain Cook was killed in an affray with the natives. It seems clear that Cook tried his best to maintain friendly relations with the natives, despite their continual thefts, and that he lost his life through his reluctance to use force till it was too late. Burney had the sad and dangerous task of demanding the remains of his captain, whose corpse had been promptly cooked and eaten. It is curious to learn that Cook could not swim; had he been able to do so, he might have escaped when he was knocked into the sea, whereas he turned back to the rocks and there met his death.

Burney afterwards commanded a fifty-gun ship which took part in Admiral Hughes's action off Cuddalore against Suffren. He was invalided home in 1785 and soon recovered, but for reasons that do not appear he was never employed again. One would have thought that Fanny Burney with all her Court influence could have secured a post for her brother, and that a competent sailor like Burney would have been given a ship as soon as the long French war began in 1793. But it was not so. The Admiralty even refused him promotion in rank and half-pay till 1821, a few months before his death. The author suggests that Burney was a little too busy with his pen and a little too ready to offer the Admiralty technical advice—that he was, in fact, something of "a sea-lawyer," and as such unpopular in Whitehall. However, apart from his nautical career, he has been immortalized as "the old Admiral" by Charles Lamb, and his wife was the original "Sarah Battle" who "next to her devotions loved a good game of whist," with "a clear fire, a clean hearth and the rigour of the game."

Birds of the Seashore. By H. J. MASSINGHAM. (Werner Laurie. 10s. 6d.).

Mr. Massingham's selection of species under this heading is a little arbitrary; indeed, he admits in his introduction that his distinctions are rather "fine-edged." The raven, for instance, is relegated to the appendix, apparently on the grounds that it has been driven to the shore by force of circumstances. This is probably true, but though ravens are again beginning to nest inland they have been typical shore birds wherever there are suitable cliffs for many years past; and many passerine species haunt the shore in certain localities throughout the year. But as the author includes most shore-loving birds, such criticism is perhaps ungracious. The descriptions are both vivid and imaginative; they reveal a sensibility to the aesthetic as well as to the scientific which will be appreciated by both nature-lovers and specialists. Though there is not much original matter, the author often gives useful hints to identification which are not found in text-books.

Mr. Massingham attributes the perfect co-ordination in the flight of flocks of waders, such as knot and dunlin, to "an unconscious telepathy, a group-personality whereby each bird co-operates with its neighbour like cells of a human body." When one watches these marvellous evolutions it is difficult to come to any other conclusion, though some observers believe that they can distinguish leadership by individuals in such flights. In watching starling flocks we have noticed that the leader is not always followed, but is left behind as the flock divides and changes direction. On one occasion we saw two starlings in a flock almost collide.

Instances of friendship between members of different species have frequently been described. The author has observed

a similar intimacy between a curlew sandpiper and a ringed plover. W. H. Hudson told a story of an attachment between a swan and a trout, and Mr. Massingham quotes him as stating that "when birds and mammals meet together they take pleasure in the consciousness of one another's presence, in spite of the enormous difference of size, voice and habits." The robin who sits on the pea-sticks contentedly singing in an undertone within a yard or two of the gardener, and pays no attention to the dainties turned up by the spade, must surely be at least pleasurably conscious of propinquity.

Now and then we hear complaints that there are too many bird books; certainly it is difficult to discover why some were ever written, but so individual a book as this will fill a place in our shelves which has hitherto been empty. There are sixty-nine illustrations in black and white, of varying quality.

Modern German Painting and Sculpture. With an Introduction and Notes by A. H. BARR. (Allen & Unwin. 10s. 6d.).

Here in brief space is a very representative collection of modern German art, excellently annotated. The introduction is clear and informative and fortunately devoid of all art-jargon.

It is quite impossible from the fifty illustrations to get any clear idea of the central inspiration of German art as a whole. I doubt if there is one, for German artists seem to fall between the strange and confused ideals of Russia and Austria on the one hand and the traditional styles of France on the other. And, for a German, art is so often a means to something else—to satire, to protest, to phantasy or to reform. Modern Germany is reflected in modern German art only in the extreme opposition of her component parts. For here in this brief collection we see old-fashioned Futurism of the pre-war Italian type jostling with French "Surréalisme" (as in the delightful absurdity of Klee called "Twittering Machine"), and Hofer's Matisse-infected landscapes side by side with a picture by the same artist that suggests Derain or even Renoir. Unexpected realism of great charm (as in the work of Dix) is marred by its obvious satire and critical quality. One German invention alone stands out as both interesting and provoking—the style of the painter Molzahn and of the sculptor Belling, who both adapt the African technique of using hollows and voids where solids might have been expected, a technique which is aesthetically sound. Belling's head of Josef von Sternberg in silvered bronze is definitely a work of the highest order and brilliance. De Fiori's "Soldier," a nude figure in stone, is sombre and almost macabre; but it is true sculpture. Kolbe's "Grief" and "Assunta" are alike splendid works but staid and conventional and formal. Kolbe has long established his position as a maker of individual figures, and his work dwarfs that of Barlach, whose skill and technique are second-rate.

Those interested in the development of regional art in Europe will find this as instructive a handbook as could be hoped for. The plates are admirably reproduced.

The Study of Rocks. By S. J. SHAND. (Murby. 6s.).

The author is Professor of Geology and Mineralogy in the University of Stellenbosch, South Africa, and is well-known as a philosophic petrologist. He has prepared a concise handbook to the classification of rocks which should be very useful to students in university and college who need a reliable and elementary textbook. About three-fourths of the book are devoted to the eruptive and metamorphic rocks. The account

of the igneous rocks follows the lines of Professor Shand's larger work, "The Eruptive Rocks," issued in 1927. The author protests vigorously against the multiplication of rock names. He deplores the existence of over 500 for the eruptive rocks, and accepts only 56, though he admits that more will have to be adopted. His antithesis in this respect is Professor Johannsen who adopts 736 families and an indefinite number of species. Professor Shand attributes the responsibility for the confusion with dyke names to Rosenbusch, whose scheme he dismisses as a mere enumeration of varieties and not a classification. The author remarks that the difficulty with rock nomenclature is due to the imperceptible transition between the different kinds, and he says this trouble does not arise in botany as the oak and the ash are different genera without intermediate forms. It is doubtful if botanists would agree as to that example, while in such cases as the roses and rubi the complexity of the problem and difficulty with the nomenclature are even greater than with rocks.

The book opens with an exhortation from Sir Jethro Teall to students to fix their attention on the rocks and not on the names; but Teall's own preference for the replacement of single names by a list of the essential constituents has not been adopted. The controversy between the "splitters" and the "lumpers" in the nomenclature of natural science is probably interminable as different workers have such different needs. Rocks are of great economic value, and the names suitable for the academic geologist are not likely to be accepted by the stone trade. Changes in a rock, which according to Professor Shand should not affect the name in petrology, fundamentally alter its commercial value. The author, in supporting the remark that schists may be of any age, gives currency to the view that there are true schists in the Alps containing belemnites and schists in Norway with trilobites. Bonney's demonstration that the Alpine rocks with belemnites were made of schist debris compressed by later movements and are not schists appears unanswerable, and the same explanation is being found applicable to the so-called trilobite schists of Bergen.

London and the Advancement of Science. By Various Authors.

The British Association for the Advancement of Science: A Retrospect. By O. J. R. HOWARTH. Second Edition. (British Association, 3s. 6d. each).

Two little volumes issued in connexion with the recent centenary meeting of the British Association deserve a friendly word. One is concerned with London's contributions to scientific study and research. Various competent writers deal with the several aspects of the matter. The Astronomer Royal, Sir Frank Dyson, has a note on Greenwich Observatory. Sir Frank Heath, who was its first head, describes very clearly what the Department of Scientific and Industrial Research has done and is doing. Dr. Bashford writes on the development of medicine in London, and Dr. Bather gives some account of the London museums. There are chapters on the learned societies—including economics and archaeology, but, curiously enough, omitting any mention of the vigorous and popular historical societies—and Mr. T. L. Humberstone gives an attractive historical sketch of London education. The introductory survey, from Chaucer's "Astrolate" to our own day, is the work of Dr. Allen Ferguson, who suggested the compilation of this pleasant volume.

The other book is a new edition, brought up to date, of the

survey of the British Association's activities which its secretary, Mr. Howarth, wrote ten years ago, at the instance of the late Sir Charles Parsons. This record contains a good deal of interesting historical matter and disposes of the widespread belief that the Association's only function is to organize an annual set of meetings. Mr. Howarth has compiled a most impressive list of good deeds done in the scientific field, directly or indirectly, by the British Association. Its "Catalogue of the Stars" should be well known. It established the Kew Observatory, now supported by the Royal Society. It initiated the National Physical Laboratory and numerous other scientific enterprises which are now on an independent footing or are supported by other means. It makes grants, valuable out of all proportion to their size, for specific researches or to particular scientific workers, in anthropology, geology, and other sciences. The function of the Association has been, and is still, to suggest, to stimulate and to guide, in these ways as well as in the annual meetings; it has fully justified its existence. Long may it continue its good work.

An Introduction to Egyptian Religion. By ALAN W. SHORTER. (Routledge. 8s. 6d.).

In electing to confine his book—intended for the general reader as well as the student—to the eighteenth and early nineteenth dynasties, Mr. Shorter has chosen wisely. Further, by dealing in the main only with the "official" religion, if he has passed over many seductive by-paths, he has gained in clarity of treatment and avoided much detail confusing to the beginner, however essential it may be in the long run to the understanding of Egyptian beliefs and religious practices as a whole.

The author brings the results of the last twenty years' exploration in Egyptology to bear upon the problems of Egypt's religion with illuminating effect. The opening of his period was critical in the history of Egypt. We can see here, as the author tells the story, how the earliest Pharaohs of the eighteenth dynasty consolidated their position by a studied emphasis on the divine character and relationship of the monarch. There can be little doubt that Queen Hatshepsut, the great queen of the eighteenth dynasty and the most remarkable woman Egypt produced, not even excepting Cleopatra, relied to no small extent on the claim to divine parentage to excuse an exceptional exercise of supreme power by a woman. In discussing the relation of this queen to the first three rulers who bore the name of Tuthmosis, Mr. Shorter adopts a solution which is the best suggested so far, though it is still difficult to reconcile with what we know of the character of Tuthmosis III. Yet almost any conjecture as to the circumstances seems to require from that king a more than Oriental tact and diplomacy quite at variance with his dominant nature. The fury of his reaction after her death is evidence of the strain he had endured.

The chapter on Akenaten and the cult of the sun disc is the best, as it is the most important, in the book. The author goes so far as to say that the king was mad. While this may be too strong, there can be no doubt that he was a degenerate and an example of the exaggerated type of egocentric aesthetic temperament bordering on the insane. He was by no means the inexplicable phenomenon of certain over-enthusiastic writers. As Mr. Shorter shows, Akenaten's revolutionary transformation of Egyptian religion was a logical, though not a necessary, development of religious and political tendencies already apparent in the days of his immediate predecessors.

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The significance of this development not only in the history of Egypt, but in the history of religion at large, lies in the fact that Akenaten's reform broke away from the anthropo-theriomorphic tradition in making the sun disc the visible object of worship; it was monotheistic in absorbing the worship of other gods, probably the first essay in monotheism in the history of the world; and it was on the way to being universal—for the first time the deity is conceived as extending his beneficent influence beyond the tribe or immediate group of worshippers. It is the surest index of the fact that Akenaten was in advance of his time, that the world had to wait for over a thousand years before this essentially modern view of religion could once more be brought to birth.

The Story of the Road. By J. W. GREGORY. (Maclehose. 12s. 6d.).

In this book the author sets out to write an account of the prehistoric and historic development of roads, of the principles of their construction and maintenance, and their value in national policy. The first, and smaller, section deals with the roads of ancient and mediaeval times, and these chapters are followed by others in which are discussed the principles of road construction, the kinds of material that are suitable for road making, and the evolution of vehicles in relation to road development, in order to lead us by way of the roads of the seventeenth and eighteenth century to those of to-day, and the problems, political and economic, which they present.

When discussing the English roads of the Middle Ages the author suggests that since travellers were—and for that matter still are—inclined to stress their difficulties and privations, the impression gained from their journals is that the roads were worse than they really were, and that until the mediaeval builders removed the paving stones, the Roman roads remained in fair order. Unmade roads across clay regions would naturally have been very bad in winter, but when wheeled vehicles were put upon roads never intended for them, travellers were scarcely able to find polite language strong enough to describe the dangers and discomforts of using them. The coming of the wheeled vehicle made it necessary to settle a fundamental question, namely, should such road destroyers be forbidden, or should the roads be made strong enough to carry any load that may reasonably be placed upon them? The discussions, enactments and experiments that led to the adoption of the latter, and to the work of men like Telford and McAdam, are summarized in an interesting manner, and the final chapter of the book deals with the development of the modern motor road and with the problems presented by the insistent demand for more and for wider roads.

Although he does not actually say so, Professor Gregory evidently does not share the views of the motorist who "looks forward hopefully to the whole country being covered by a network of straight wide thoroughfares . . . having a transparent wire fence instead of hedges, to the surface being so smooth that horse traction is impracticable . . . and to the absence of any picturesque distraction except the mile-stones, direction posts, and the petrol pumps." On the contrary, his sympathies are with those who regard this prospect with dismay—with "those who admire rural scenery and our country roads, with . . . their hedgerows sheltering song birds and the infinite variety of view from their winding courses." If a second edition of this book is called for, which is likely, the author would be able to devote more space to some important

matters such as road construction and the factors that have determined road routes, if, in the chapters that summarize the literature of road history, the frequent repetitions that occur were avoided.

Merchant Venturers in Bronze. By HAROLD PEAKE and JOHN FLEURE. (Oxford University Press. 5s.).

It must be said at once that the authors of this book have not got a happy style. The material they give in the course of their description is not set forth in such a way that it is at once and immediately comprehensible to the ordinary reader. Names of scholars often known only to the professional expert are scattered through the text without any reference to their works or to their origin. Archaeological jargon is on every page, and there is no trace of a quickening enthusiasm of style which might recreate the lost worlds that are described. So far in adverse criticism. For the rest the short chapters and admirable illustrations go far to balance defects of style and description. But, even so, the book is still far from being an explanatory text-book useful to the intelligent amateur or the enquiring student.

The survey is of the full Bronze Age of the ancient European and Near Asiatic world. The field is therefore a very wide one. The British, Cretan, Iberian, Central European and other outstanding developments of the Bronze Age are fully discussed. But much disputable matter is stated as if it were accepted fact, and there are some dubious dogmas. Thus (p. 13) copper can be made harder even than bronze by cold working and smithing. We are told vaguely of the wooden circle at Bleasdale and left to look in vain for any reference to a publication of it. The "brisk trade" between Crete and Spain and Portugal is mere hypothesis and far from proved (p. 81). Nor is there any reliable evidence that "Cretan traders were visiting Malta." Malta lived a singularly isolated life of its own. The questionable use of the term "Hellenes" for what archaeologists call Minyans is most misleading to the student. Greek-speaking they may have been, but in any case the term "Hellenes" refers primarily to Dorian Greeks. Here it is a misnomer. On the other hand, the authors' solution of the problem of the Mycenaean tholos tombs is refreshingly simple, and seems reasonable.

There is no possible doubt that the book is a deeply interesting one. But it is difficult to read, and dry in style. For handbooks with the alluring titles that these have one is led to expect a certain raciness of style and a certain swift descriptive power. The reader will be disappointed in such expectations. But he will certainly get all the facts he requires.

South Georgia. The British Empire's Sub-antarctic Outpost. By J. HARRISON MATTHEWS. (John Wright & Sons. 15s.).

South Georgia, lying in the Antarctic seas to the south-east of the Falklands, was named and annexed for Great Britain by Captain Cook in 1775. It has served as a whaling station at intervals until the present day, and it was the resort of sealers until the supply of fur seals was exhausted. It is a large island, a hundred miles long by thirty wide, but its mountainous interior is little known and has only once been crossed—by Shackleton and his comrades in their desperate journey to obtain help for his shipwrecked crew. The climate is naturally inclement. Reindeer thrive, but no other animals of use to man can endure the cold and damp. However, the island is properly administered as a British outpost, and the Norwegian whalers

who make it their resort are decent men, except when bad liquor is smuggled into the island from Argentina.

Mr. Matthews, as a scientific member of the "Discovery" expedition of 1924-27, spent a good deal of time in South Georgia and studied the birds and seals. In this new book he gives what is certainly the most detailed history of the island, with a description of its scenery and its flora and fauna. His chapters on the sealing and whaling industries are of special interest. The fur seal fishery was ruined by sheer greed and brutality. Male and female seals were slaughtered alike, in tens or even hundreds of thousands, with the natural result that the species was exterminated a century ago. The elephant seals lasted longer, as they were not so easy to catch, but they too were almost extinct by 1880 when the industry was abandoned in face of the competition of mineral oil. The elephant seals have revived since then, but fur seals have never returned to South Georgia. The whaling industry, conducted nowadays with the most approved methods of slaughter, has threatened the whale with the fate of the fur seal. Fortunately for the animal the industry has expanded too rapidly and brought so great a fall in prices by over-production that operations have been suspended for a year. Meanwhile, it may be hoped, the new international convention to regulate the whale fishery will be ratified. It would be indeed ridiculous if the few countries concerned could not agree to control and preserve the fishery which otherwise will soon cease for lack of whales.

The Travels of Marco Polo. Translated into English from the Text of L. F. Benedetto by ALDO RICCI, with an Introduction and Index by SIR DENISON ROSS. (Kegan Paul: The Broadway Travellers. 21s.).

For most readers the Broadway Travellers edition of this most famous of travel books will supersede all others in English. For although Yule's version, with Cordier's additions and commentary, must always remain indispensable to the student, this translation of the Italian version prepared by Professor Benedetto after the publication of his great critical edition of the Paris geographic text is not only convenient and pleasant to handle and to read; but it incorporates important additions from manuscripts discovered in the course of preparing that edition. Sir Denison Ross has provided an introduction dealing with the texts and a unique index which serves as glossary, corpus of notes and gazetteer, in which, however, it is surprising to find some omissions. The late Professor Ricci has departed from the Yule tradition in translation, which has been followed by other English editions, whether complete or abridged, for reasons given in a letter quoted in the introduction. His wisdom is made apparent by the result. His translation is excellent, preserving the *naïveté* of the early traveller while avoiding the archaisms which many have found tedious.

Oil Ships and Sea Transport. By A. C. HARDY. (Routledge. 10s. 6d.).

Scientific and commercial interest in the development of oil as the motive power of merchant shipping is growing rapidly, and to all who seek a clear, full and not too technical survey of the subject this book can be heartily recommended. The author is a lecturer on shipping at the City of London College and an authority both on oil and oil ships. He has brought together within the pages of this volume material from his pen already published in various technical papers, and the substance

of a number of his lectures both in London and at University College, Southampton. The general reader may be grateful for this handy compendium of information, at once severely practical and entertainingly written. The Author's attitude to oil as an agent of civilization—in contra-distinction to the view, tenaciously held by another school, that it plays a sinister part in world affairs—is part and parcel of a cheery optimism that glows on every page of the book, an unshaken faith in the "Aristocracy of Commerce" as the successor of the "Aristocracy of the Battleaxe." But it is churlish to question Mr. Hardy as a political philosopher when he has given us so interesting a narrative of the value of oil as the elixir that is putting new life into the merchant ships of the world.

Two Thousand Years of Science. By R. J. HARVEY-GIBSON. Second Edition, Revised and Enlarged by A. W. TITHERLEY. (Black. 12s. 6d.).

Dr. Titherley, two years ago, completed his late colleague Professor Harvey-Gibson's book and saw it through the press. Now he has revised and greatly enlarged the book for a second edition. It is clear that such a compact history of science and of leading scientists was needed, and the new edition should be as popular as the first. Dr. Titherley's plan is, after the brief introductory pages, to take each science and show how it developed in three periods—up to Newton, from Newton to Darwin, and in our own day. He enters somewhat minutely into each subject, and is careful to give credit to the great men who have been responsible for each theory or discovery. He is courageous enough to try to explain the quantum theory, and he devotes some space to the latest speculations on the transformation of matter into energy. Modern biology and chemistry are treated at some length, and geology is not forgotten. At the end are chronological tables of scientific discovery, the formation of the earth and the epochs of human history. Anyone, young or old, who is seriously interested in natural science—and who should not be?—could read this book with profit.

The Romance of the Merchant Ship. By ELLISON HAWKS. (Harrap. 7s. 6d.).

The tale of the Merchant Navy is never told. So far as the subject can be encompassed in the covers of one book, Mr. Hawks has told the story, and told it attractively; it is certainly fascinating reading for boys of all ages. The history of the merchant ship, her many forms, her tricks and technicalities and construction are here told concisely and with a wealth of good illustrations. Whatever the average age of the public for which it was written, it is an admirable *vade mecum* for the landsman of ships and their ways. Those who have not followed the sea feel a certain uneasiness when nautical language is used and nautical subjects are under discussion. For a maritime race we are sadly deficient in knowledge of the past and present of the ships upon which our lives depend. This book leaves no excuse for further deficiency. We wish it could be made a text-book in every British school.

THREE printing errors call for correction in Professor Fraser-Harris' article, "A Little-Known Discourse by Faraday," in *Discovery* for October. On page 312 "counter-agreement" should read "counter-argument," "initial phases" should read "inertial phases," while 1916 and not 1906 was the date of Professor Paton's publication.

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